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ENGINEERING PROJECT AUTHORIZATION

PROJECT NO: CS-P-15

PROJECT LEADER(S): Ying Xiang

TITLE: 7 7/8 IADC 5-1-7 CUTTING STRUCTURE OPTIMIZATION (51X KILLER)

CODE: P

OBJECTIVES

Utilize the IDEAS program and IDEAS lab facilities to design, analyze and optimize a new 7 7/8 TCI cutting structure(s) targeted to increase the rate of penetration, footage, and durability compared to the currently available IADC 5-1-7 type products (especially the Reed HP51X). Iteratively field test these new designs with the ultimate goal of establishing a 15% to 20% performance differential with our competitor's products and additionally providing functional feedback for continuing IDEAS systems development.

CUSTOMER NEEDS ADDRESSED:

- 1) Performance
- 2) Reliability

TRANSLATION:

- 1) Increased ROP
- 2) Improved life and footage
- 3) Consistent dull condition

MEASUREMENTS:

- 1) Performance Reports
- 2) Analytical/Statistical Reports
- 3) Lab Tests

BENEFITS/PAIN:

Project benefits are to: 1) establish a performance advantage over our competitors in the 7 7/8 IADC 5-1-7 product range, 2) increase marketshare/revenues in the domestic TCI market, 3) further promote the utilization of the IDEAS program and lab to improve product performance, and 4) enhance our customer's perception of Smith as a leader in technological development. Potential pain is continued lost marketshare/revenues to Reed and other competitors who dominate the market for 7 7/8 5-1-7 type products.

DESIGN INPUT ACCEPTANCE:

Ying Xiang
Project Team Leader

11/13/98

Date

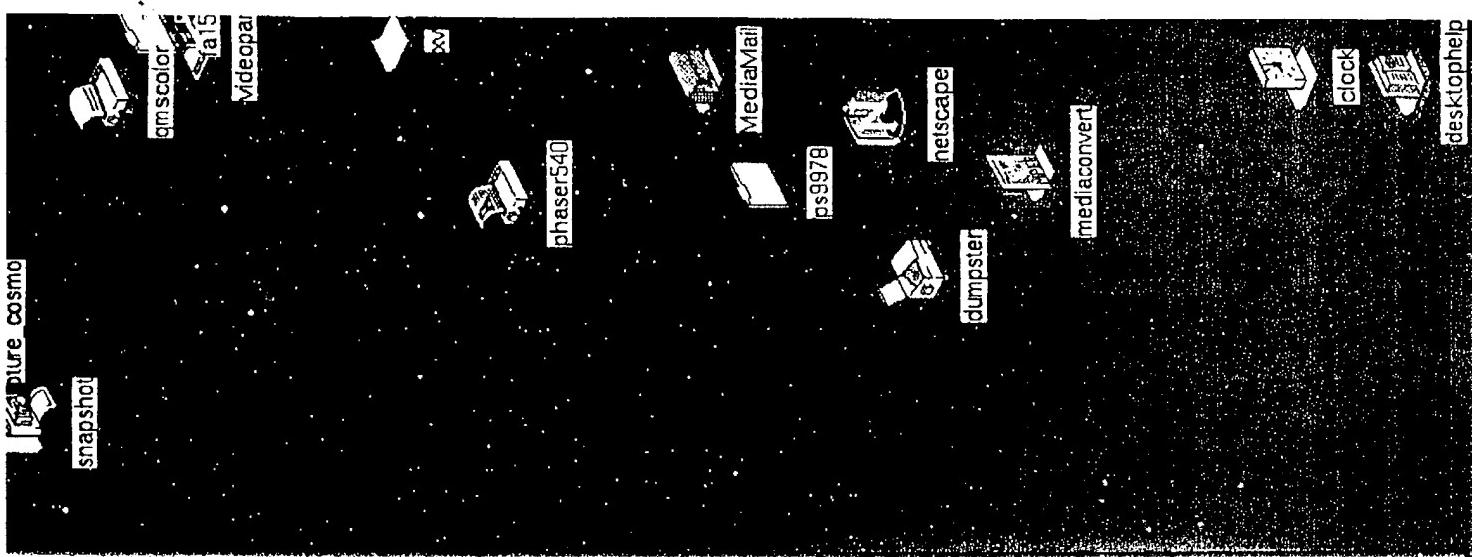
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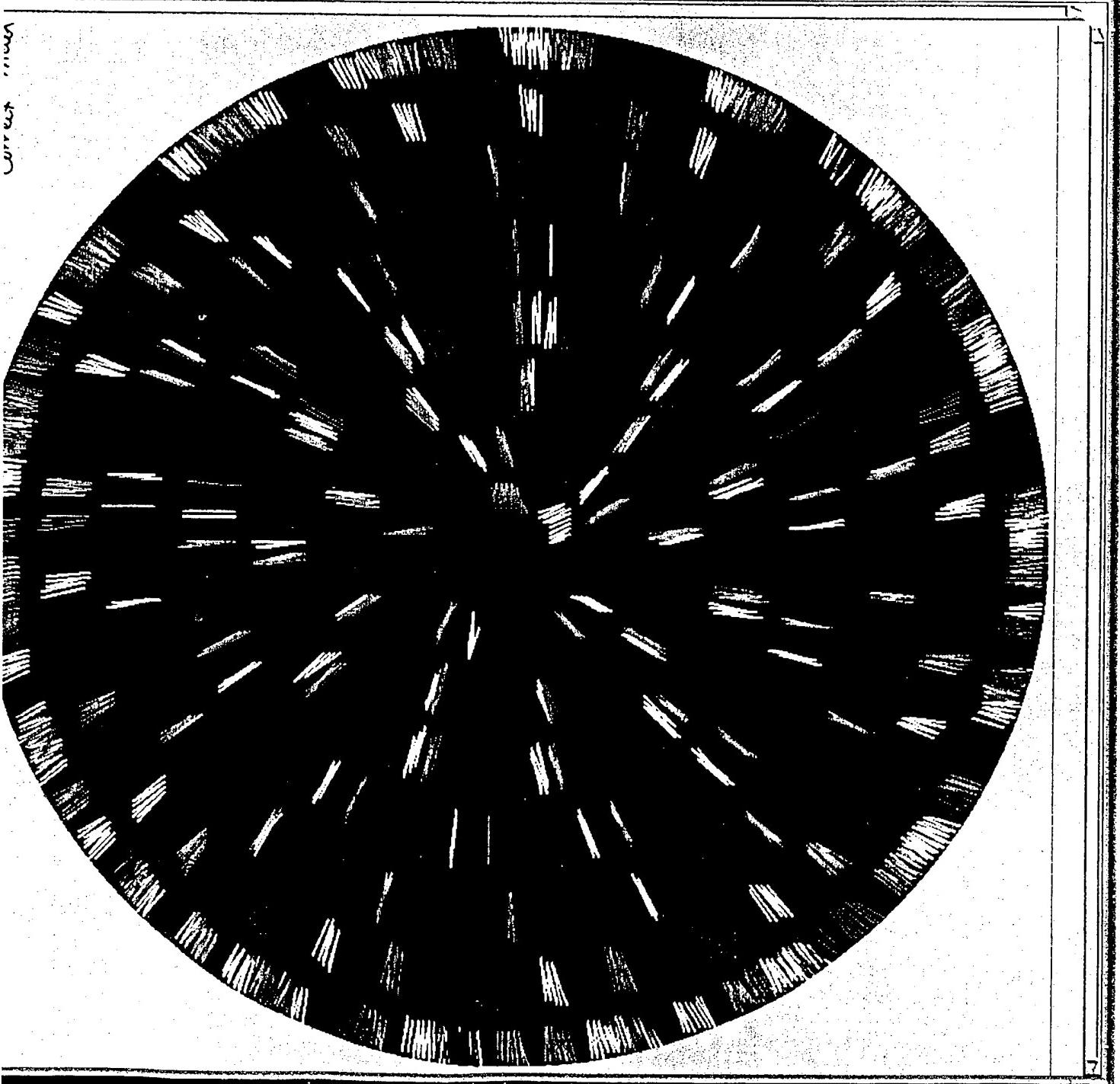
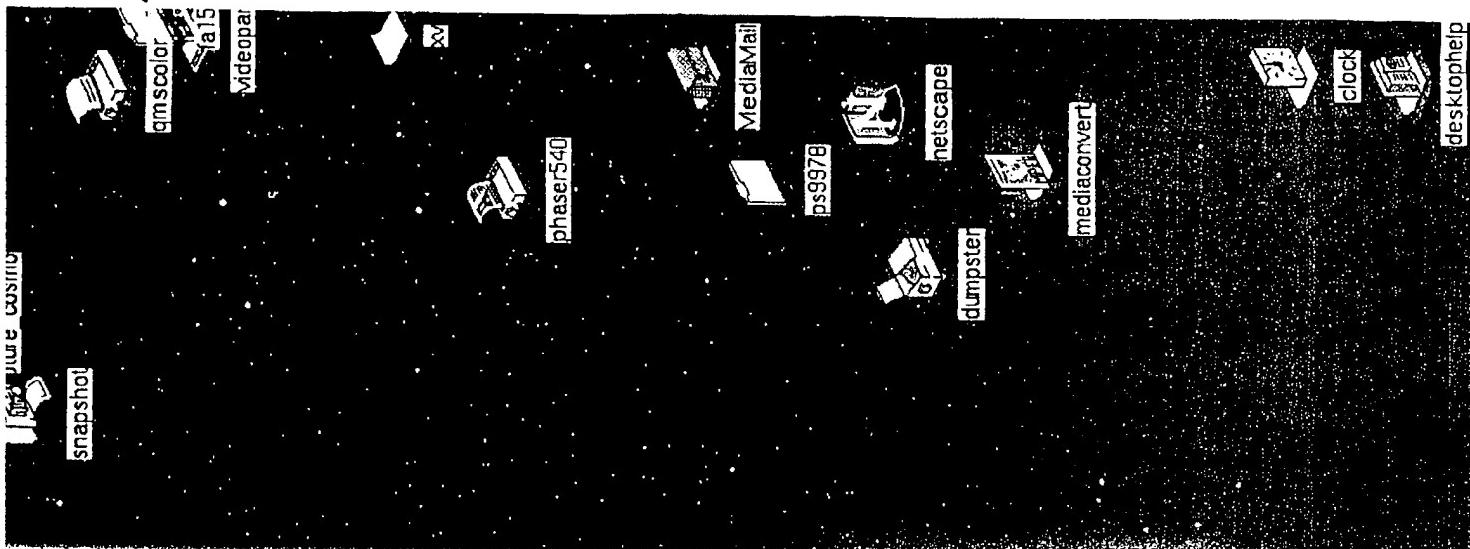
E. C. Smith
V.P. Engineering Smith Tool

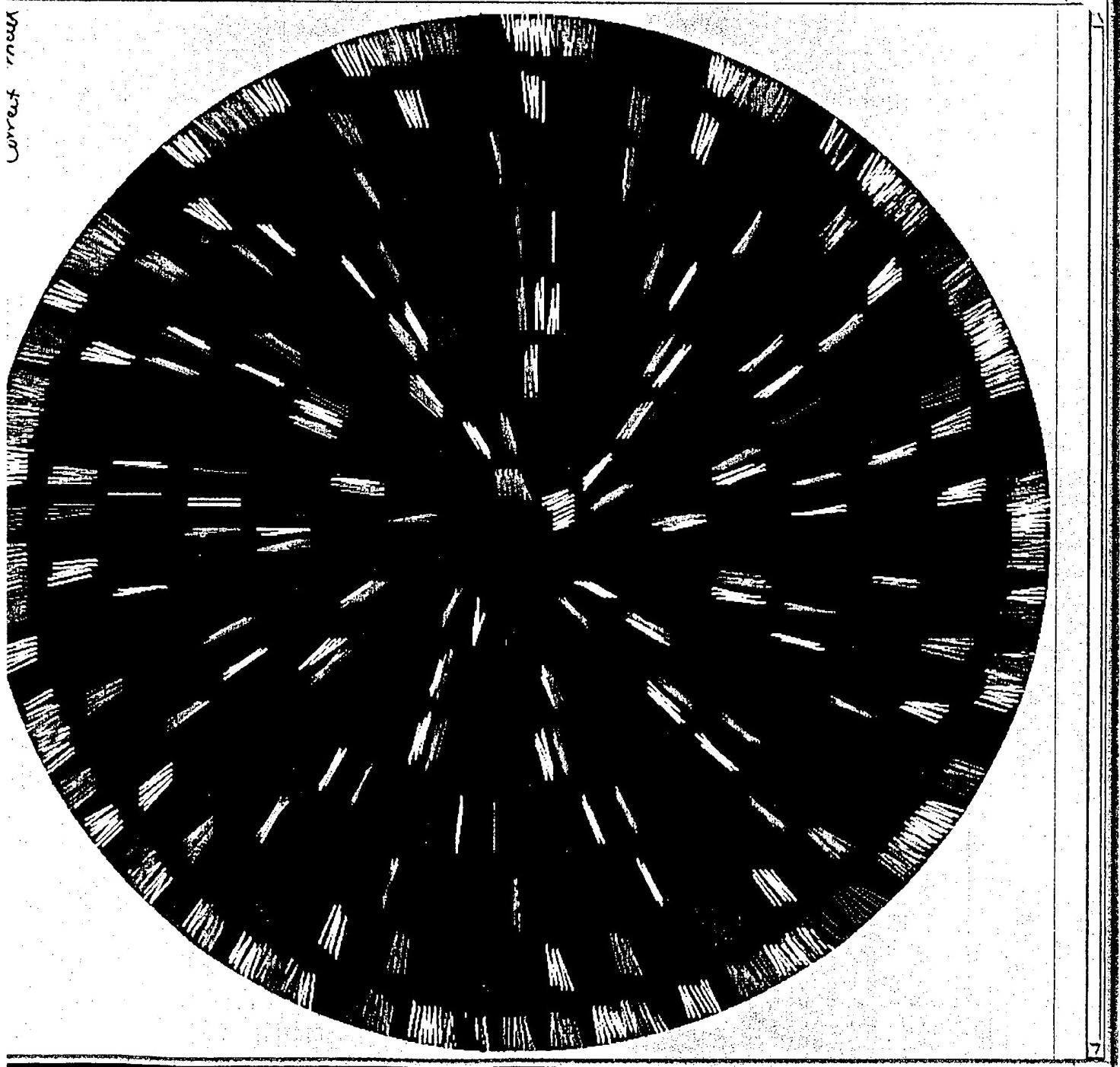
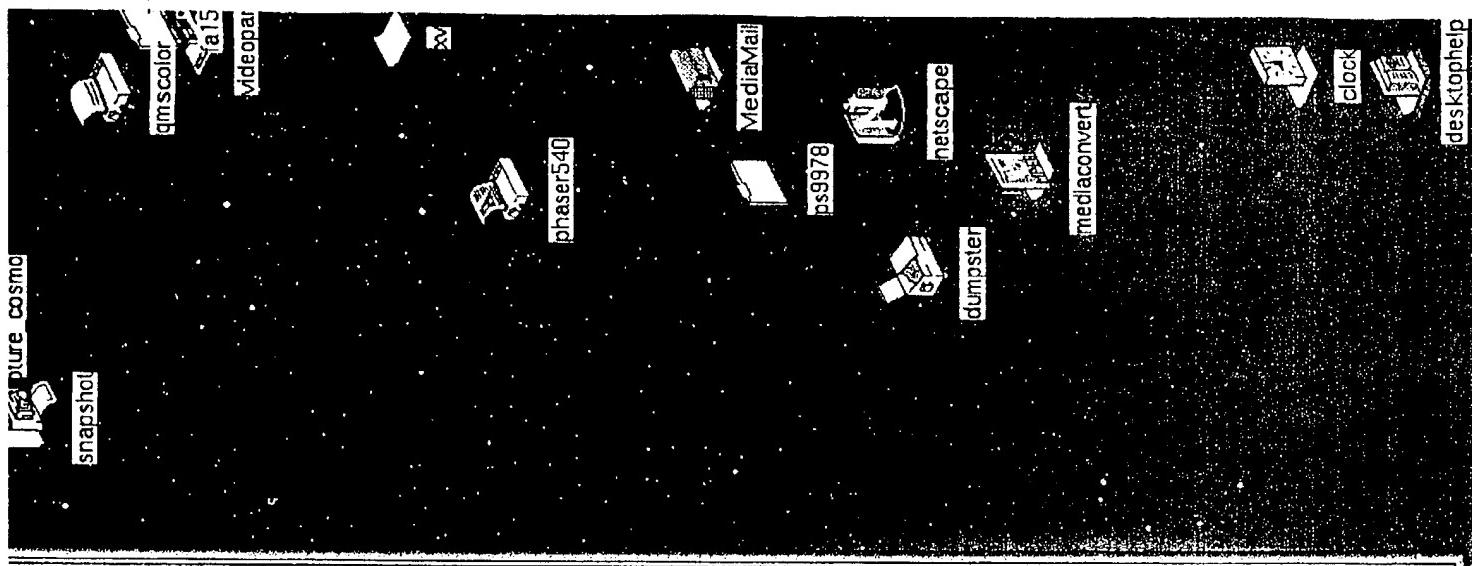
11/17/98

Date

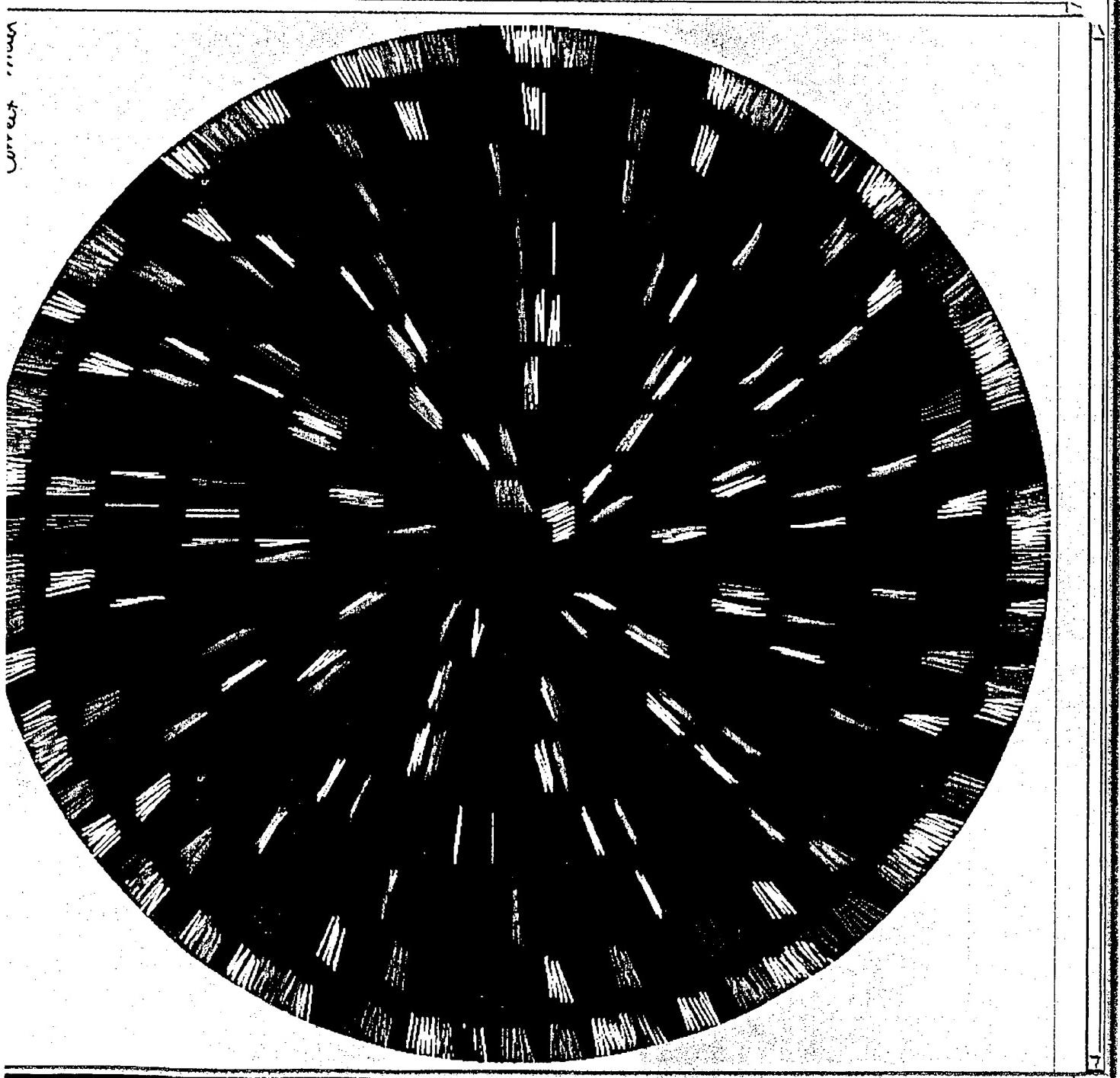
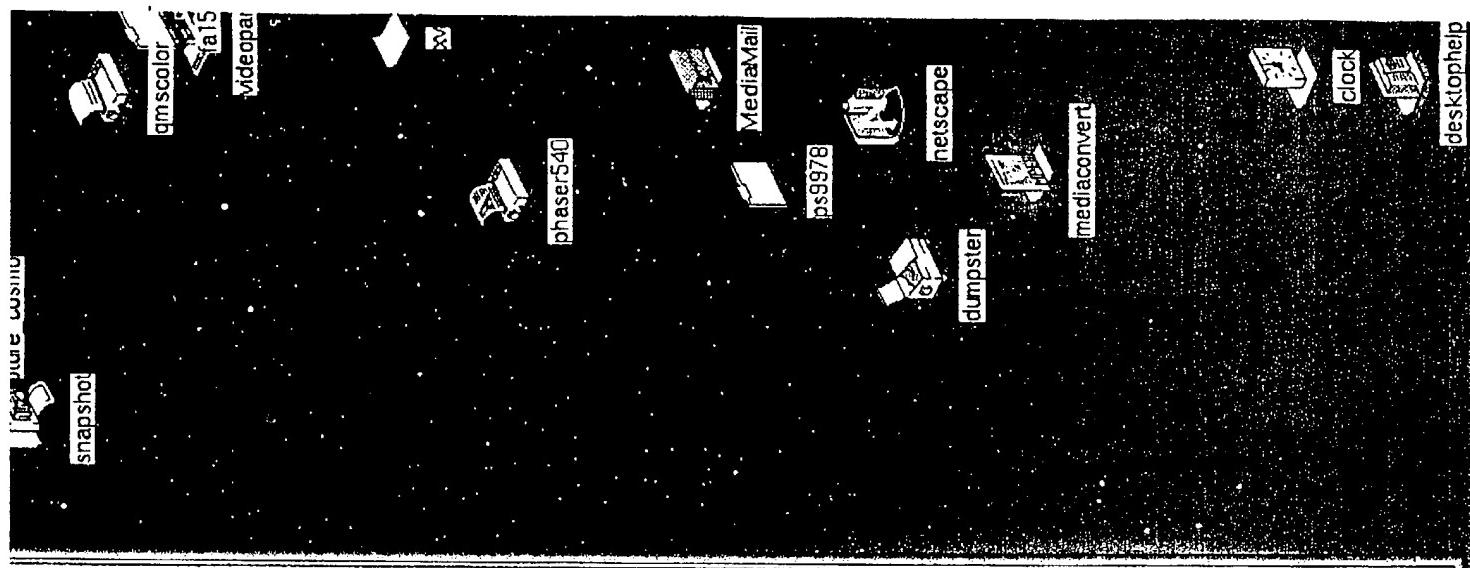
FISHER 5754

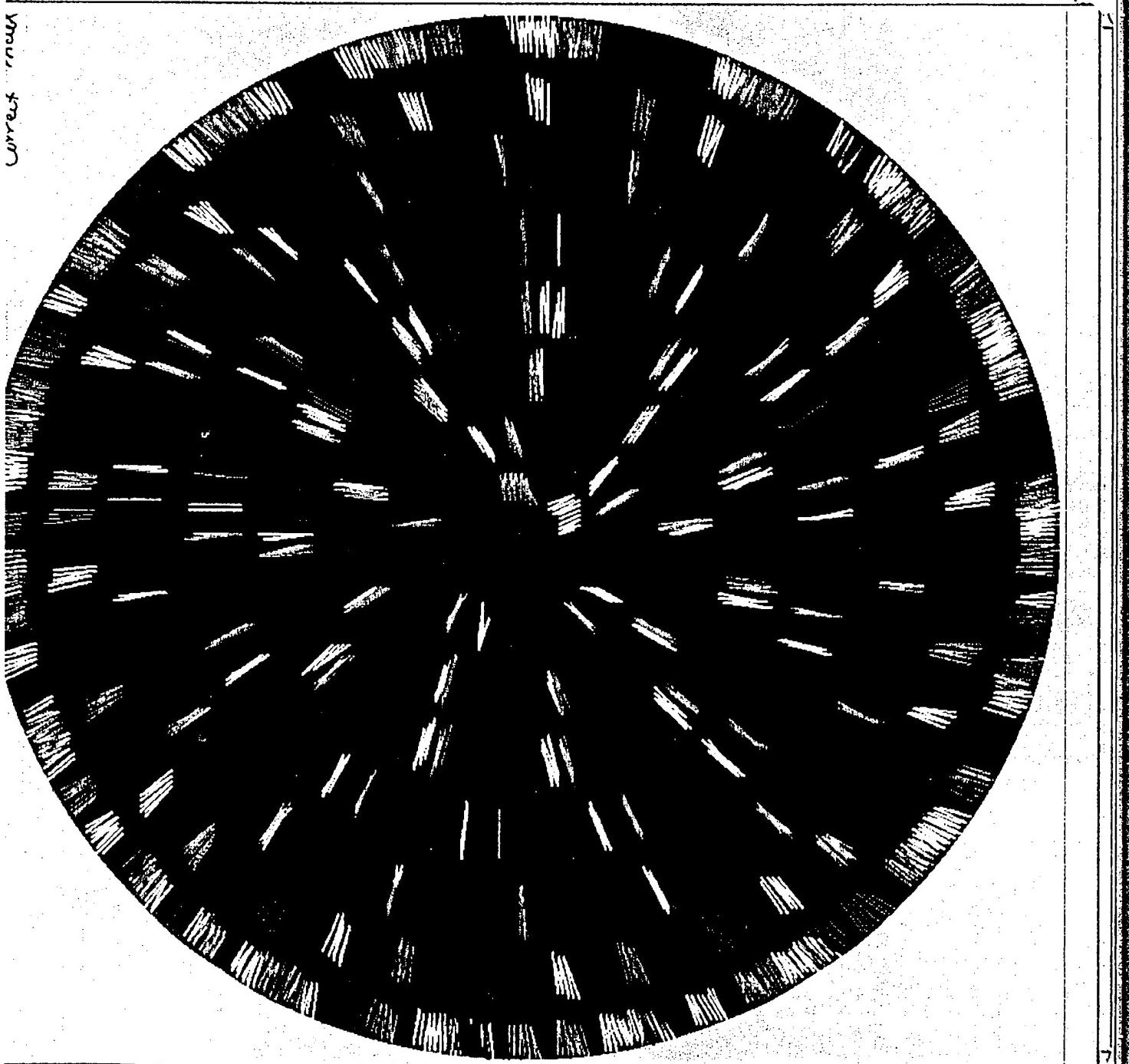
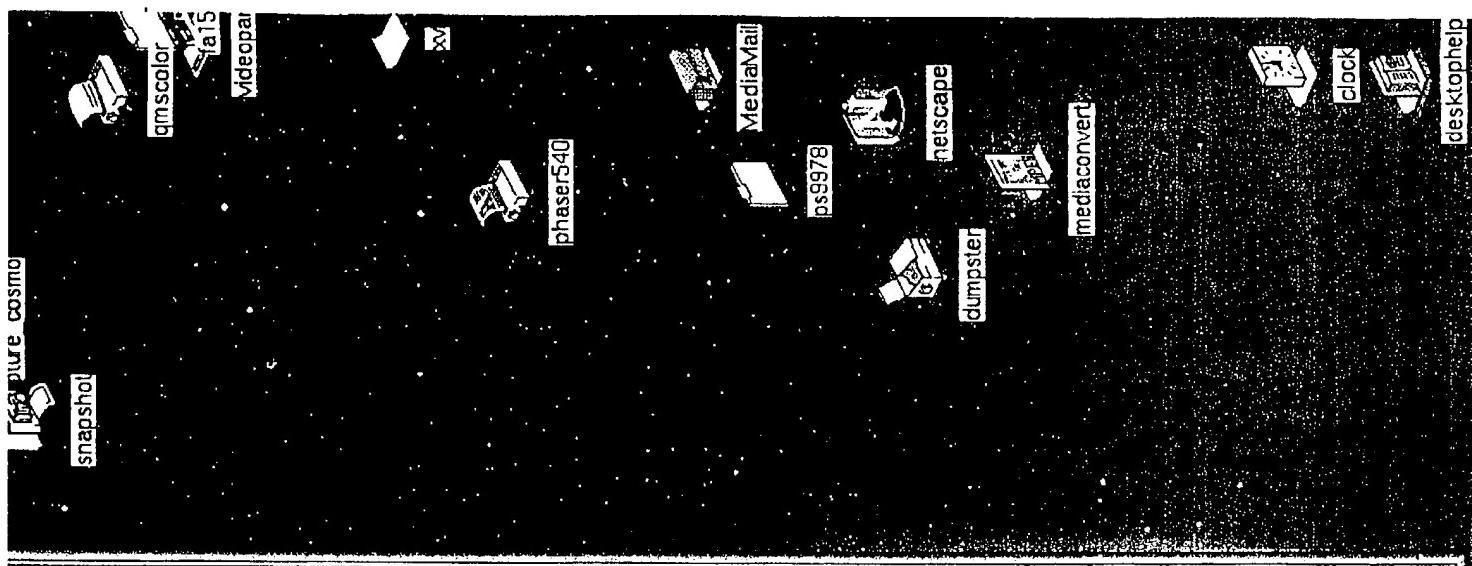


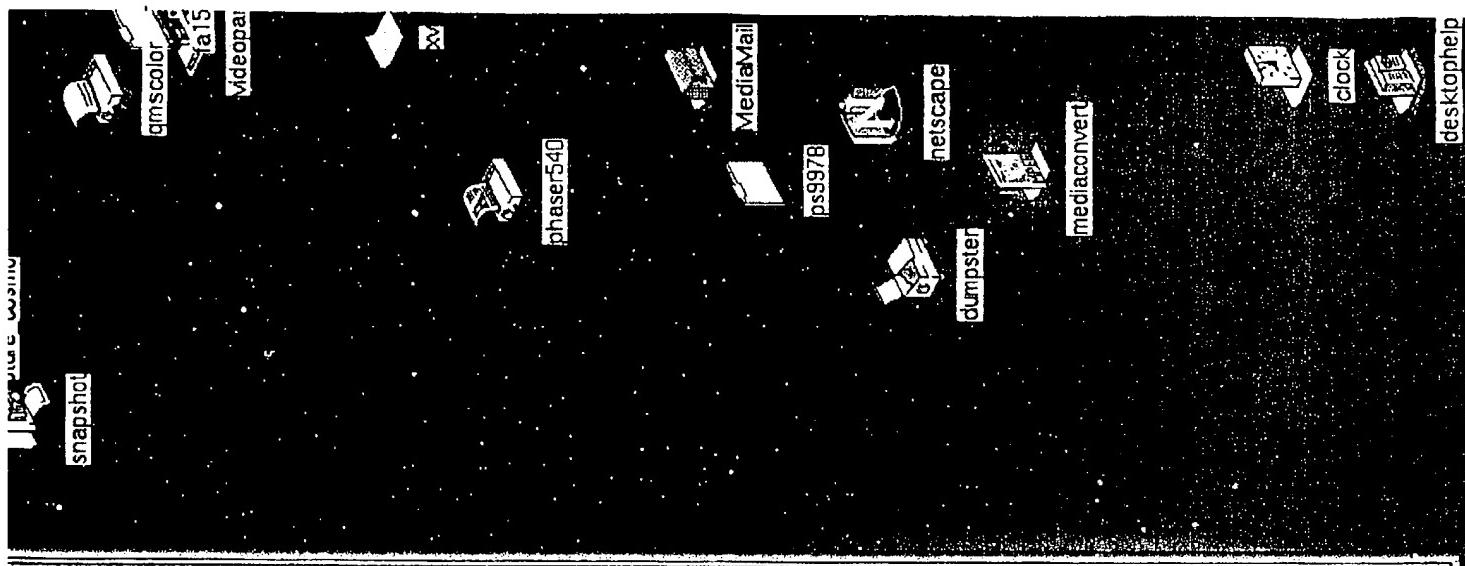




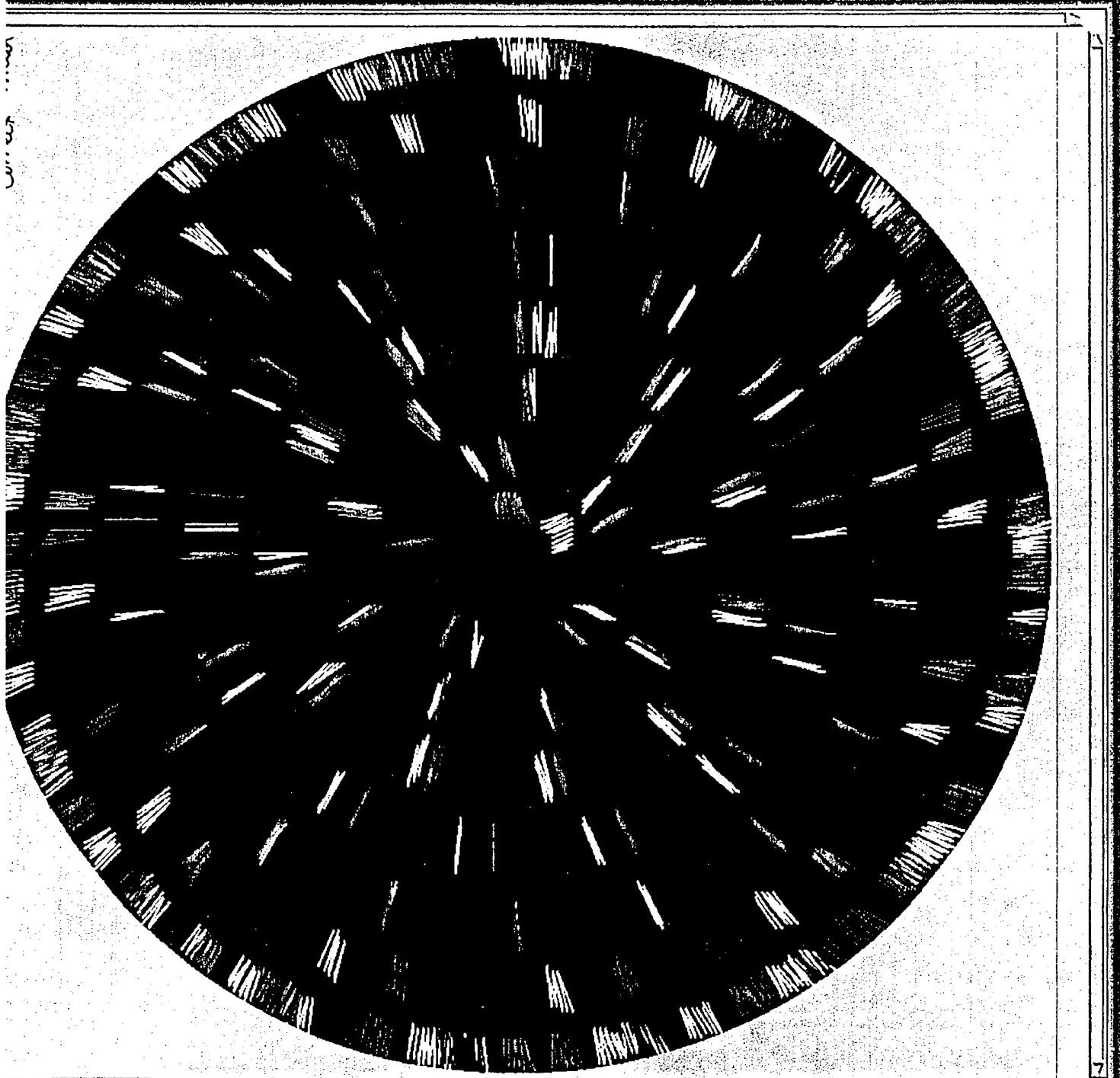
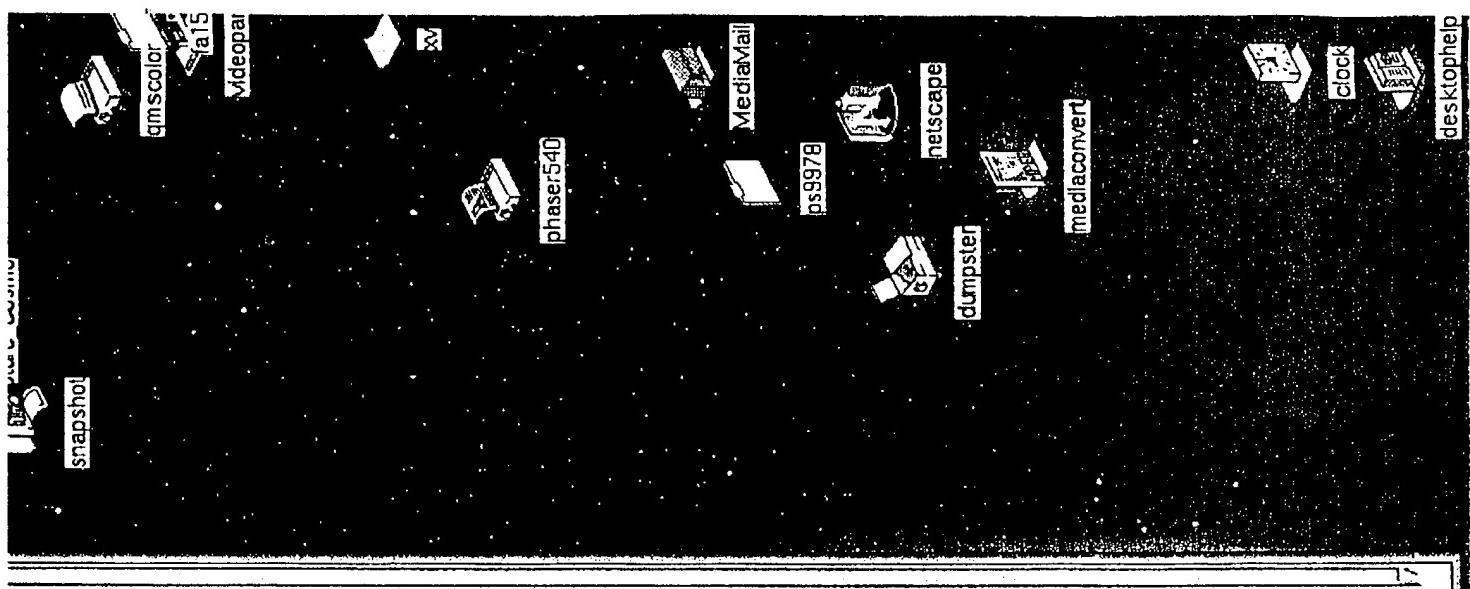
desktophelp

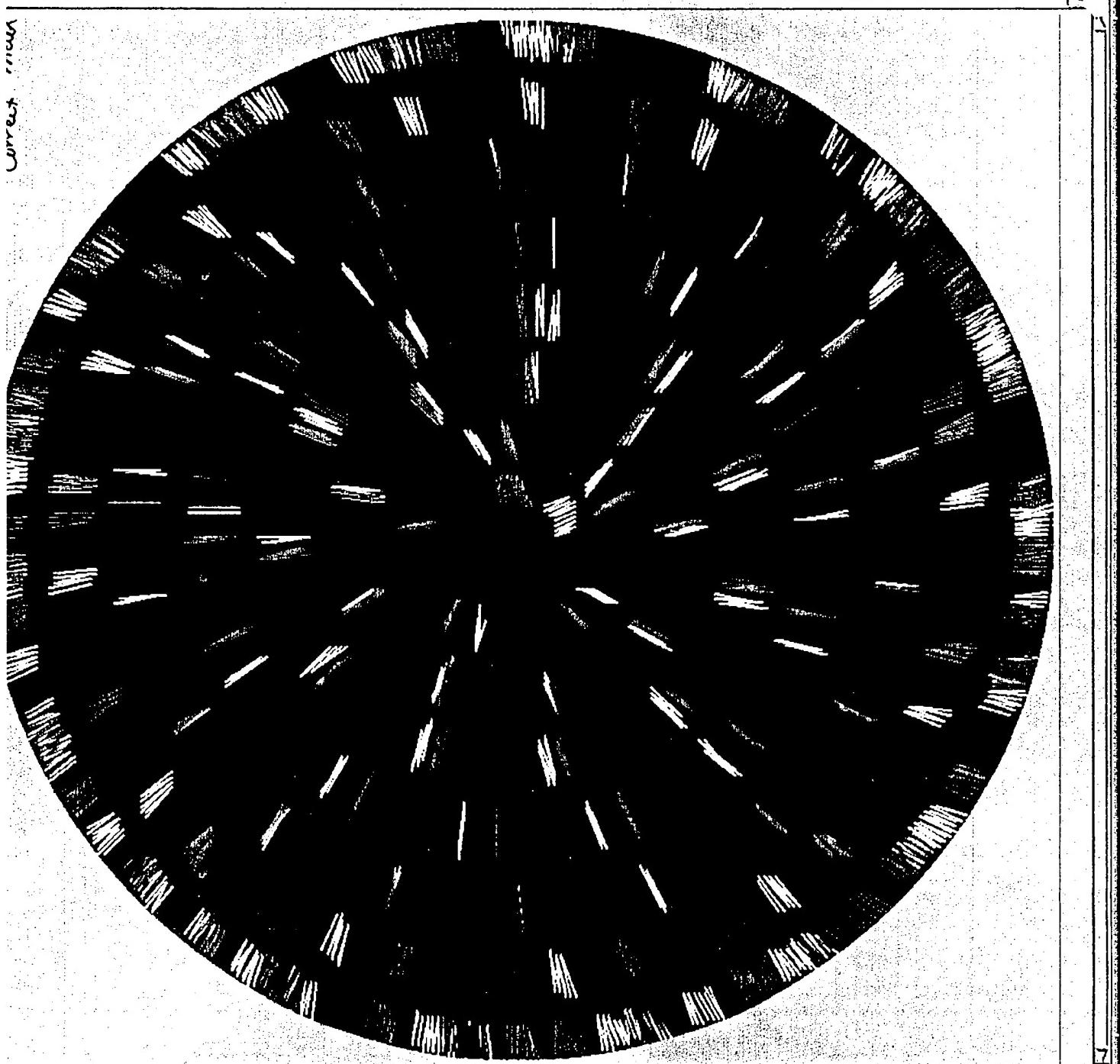
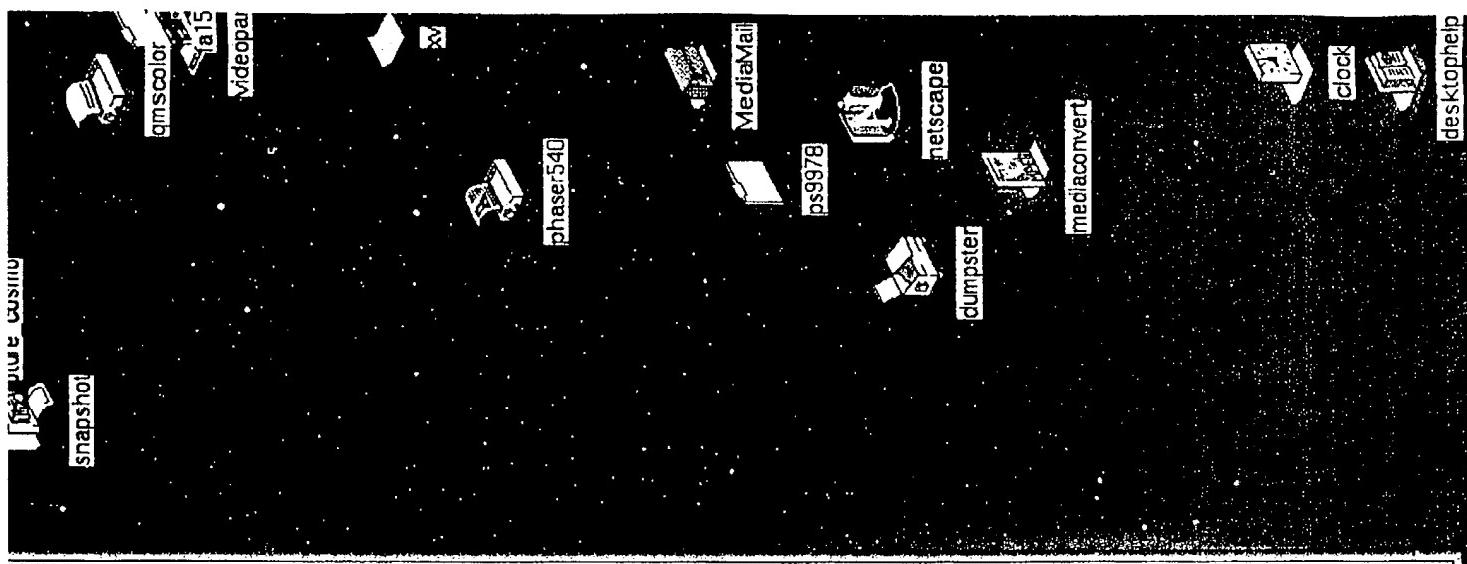


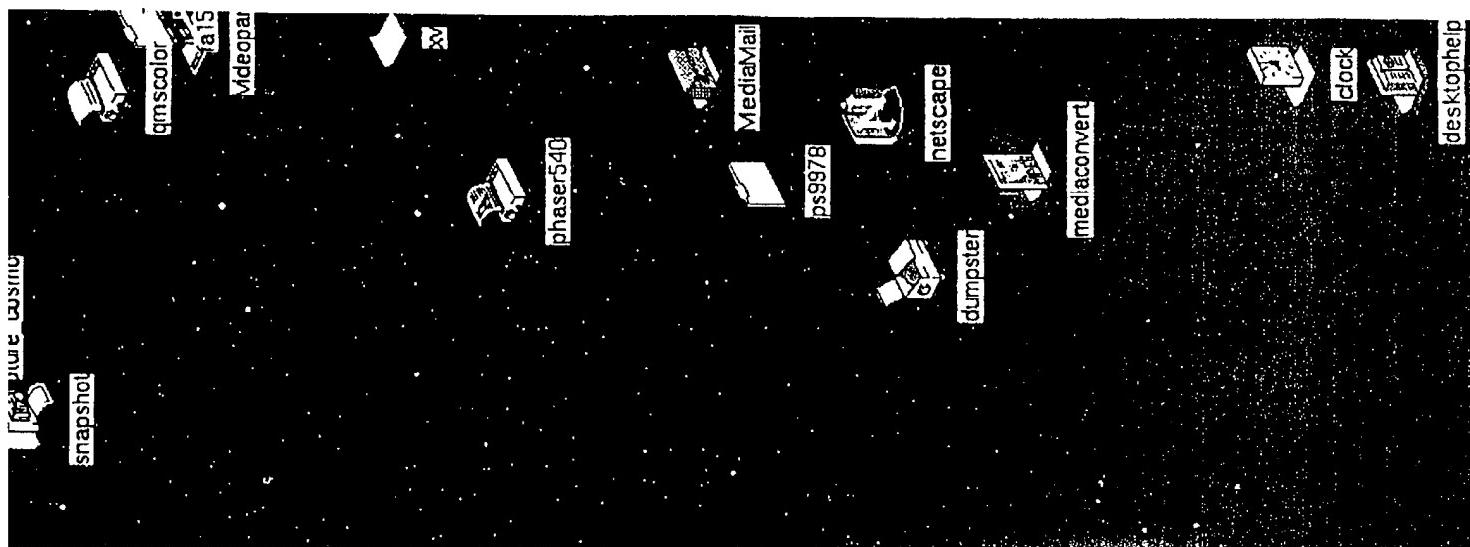




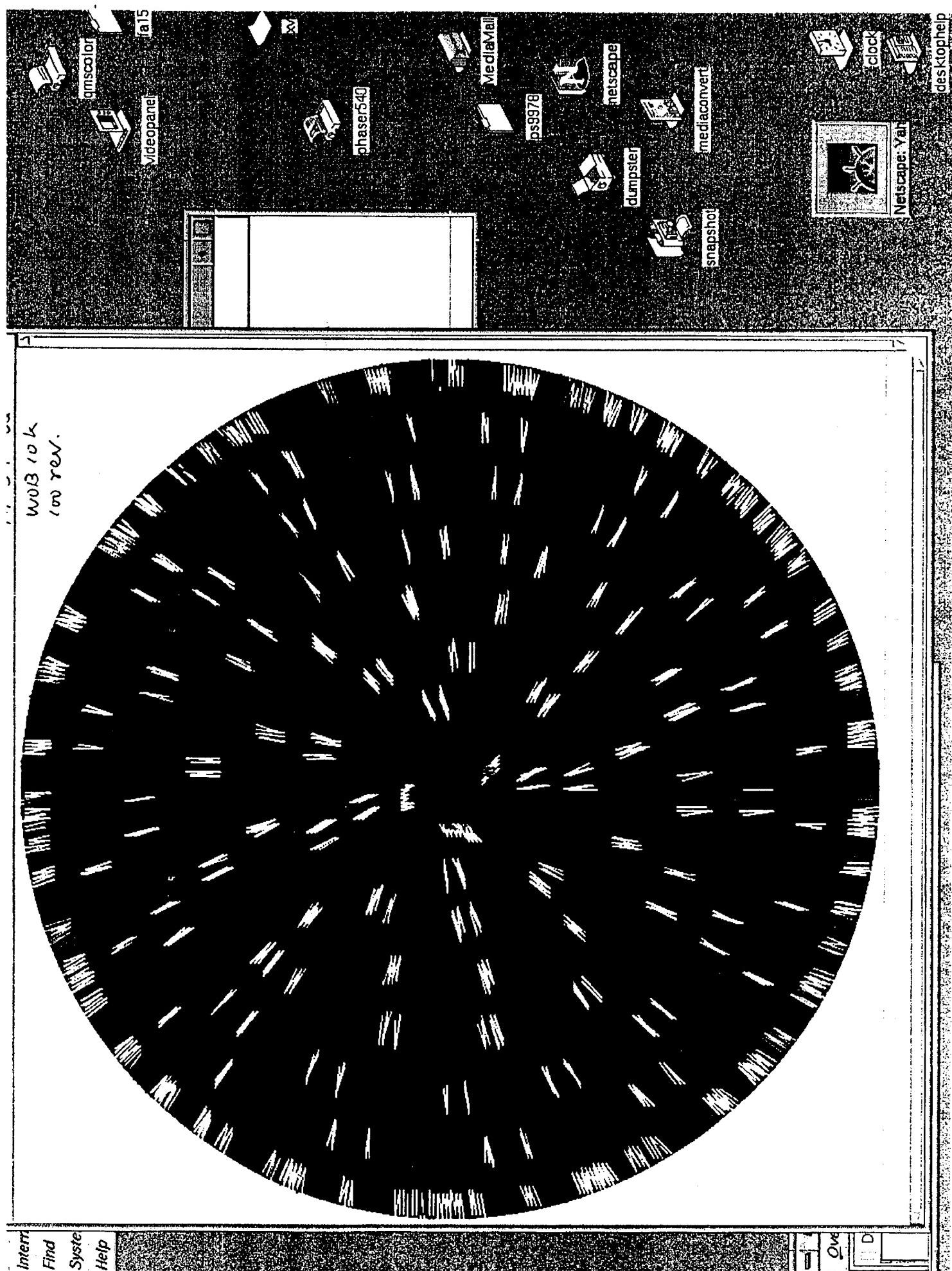
desktophelp







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Calculation Summary

ct: ./f15h1aa
 ter of Bit: 7.87 (in) [200 (mm)]
 t on Bit: 42000 (lbf) [19051 (kgf)]
 utions per minute: 85 (rpm)
 utions of Simulated: 30 (rev)
 ess coefficient of Rock: 134954 (lbf/in²) [930.5 (Mpa)]
 ritical Contact Depth of Rock: 0.054 [in] [1.4 (mm)]
 breakage Factor of Rock: 95.006 (Mpa/mm)
 ole area: 48.707 (sq.in)

CutArea Coverage

	(sq.in)	%
15.17	31.14	
16.91	34.71	
18.68	38.35	
18.26	37.48	
18.62	38.22	
20.64	42.37	
20.80	42.70	
20.67	42.44	
20.49	42.06	
20.90	42.91	
22.05	45.27	
20.75	42.60	
20.94	42.99	
21.75	44.66	
21.96	45.08	
21.39	43.92	
20.92	42.95	
21.04	43.19	
21.31	43.76	
20.39	41.87	
20.88	42.87	
21.13	43.38	
21.04	43.20	
20.42	41.93	
21.65	44.45	
21.18	43.48	
21.44	44.03	
21.17	43.45	
21.24	43.61	
21.24	43.61	

ge of Coverage for Bit: 42.09 %

ge of Coverage for Each Row:

Row	Rmin (in)	Rmax (in)	C.Avr (sq.in)	CovI %	CovA %
1	3.886	3.937	0.002	0.12	0.00
2	3.726	3.937	0.019	0.36	0.04
3	3.154	3.851	2.148	14.02	4.41
4	2.055	2.815	3.266	28.08	6.71
5	0.773	1.428	0.829	18.30	1.70
6	0.210	0.704	0.034	2.40	0.07
1	3.884	3.937	0.005	0.36	0.01
2	3.484	3.937	1.838	17.40	3.77
3	2.488	3.247	3.813	27.88	7.83
4	1.205	1.852	1.550	24.95	3.18
5	0.229	0.690	0.045	3.38	0.09
1	3.884	3.937	0.003	0.24	0.01
2	3.534	3.937	0.388	4.09	0.80
3	2.832	3.595	3.777	24.51	7.76
4	1.595	2.319	2.497	28.04	5.13
5	0.429	0.972	0.212	8.90	0.44

penetration Depth 0.249 (ft) [76 (mm)]

ge of ROP 38.70 (ft/h) [11.79 (m/h)]

of Cone Rotary Speed to Bit:

Ratio

1.2176
1.2581
1.2223
ing Brittle File Size 5003400 (bytes)
cal Brittle File Size 3705012 (bytes)
Contacted Times 849 (times)
ct Percentage of Shell to Rock 23.5833 %

Calculation Summary

ct: ./f15h17
ter of Bit: 7.87 (in) [200 (mm)]
t on Bit: 42000 (lbf) [19051 (kgf)]
utions per minute: 85 (rpm)
utions of Simulated: 30 (rev)
ess coefficient of Rock: 134954 (lbf/in²) [930.5 (Mpa)]
ritical Contact Depth of Rock: 0.054 (in) [1.4 (mm)]
breakage Factor of Rock: 95.006 (Mpa/mm)
ole area: 48.707 (sq.in)

CutArea Coverage

(sq.in) %

13.15	27.00
13.45	27.62
15.99	32.83
17.90	36.75
19.16	39.34
18.72	38.44
18.10	37.16
19.03	39.08
19.44	39.92
18.89	38.77
19.97	41.01
19.35	39.72
18.09	37.13
18.30	37.58
18.84	38.69
18.07	37.09
19.37	39.77
19.20	39.41
19.96	40.98
19.21	39.44
19.38	39.79
20.33	41.74
18.94	38.88
19.49	40.01
19.73	40.51
19.20	39.42
19.99	41.04
19.19	39.40
20.25	41.57
19.06	39.14

ge of Coverage for Bit: 38.31 %

ge of Coverage for Each Row:

Row	Rmin (in)	Rmax (in)	C.Avr (sq.in)	CovI %	CovA %
1	3.907	3.937	0.000	0.00	0.00
2	3.318	3.937	1.161	8.22	2.38
3	2.884	3.572	2.868	20.54	5.89
4	1.377	2.045	2.072	28.87	4.25
5	0.105	0.554	0.064	6.85	0.13
1	3.890	3.937	0.000	0.00	0.00
2	3.323	3.937	2.096	14.95	4.30
3	1.848	2.593	2.978	28.63	6.11
4	0.454	1.014	0.367	14.24	0.75
1	3.907	3.937	0.000	0.00	0.00
2	3.321	3.937	1.707	12.15	3.50
3	2.387	3.150	3.813	28.75	7.83
4	0.899	1.533	1.316	27.14	2.70

penetration Depth 0.149 (ft) [45 (mm)]

ge of ROP 23.44 (ft/h) [7.14 (m/h)]

of Cone Rotary Speed to Bit:

Ratio

1.2623

1.2214

1.2788

ing Brittle File Size 3660912 (bytes)
cal Brittle File Size 2933052 (bytes)
Contacted Times 1694 (times)
ct Percentage of Shell to Rock 47.0556 %

Peer Review

Project Information:**Page: 1**

Title: 077 mf15h

Number: CS-P-15

Leader(s): YING XIANG

Meeting Schedule:

Date: Mar.30, 1999

Time: 9.00AM

Place: ROOM2000

Meeting Objectives:

- Design review

-
-
-

Agenda Topics**Time Allotment**

► Review Product Brief	<input type="checkbox"/> PDP	<input type="checkbox"/> ECR	<input type="checkbox"/> CAR	<input checked="" type="checkbox"/> EPA	0
► Review 077-mf15h -93 Layout					45 min
► open discussion					15 min
►					30 min
►					
►					
► Recap Meeting and Action Items					5 min

Invitedees: (Attendance indicated by signature)

Name:	Signature:	Name:	Signature:
Jim Minikus		John Williams	
Mary Garcia		Dennis Cisneros	
Red Garbrecht		Gary Portwood	
Cott McDonough		Paul Wood	
Ryan Chenevert			
Mike Oliver			

Design Review Result: Unconditional Approval
(No change required) Conditional Approval
(Action items must be completed) Another Design Review Required
(Redesign and conduct another design review)**Verification:**

Manager/Supervisor Signature:

Date: 12 APR 99

Peer Review

Project Information:

Page: 2

Title: 077mf15h

Number: CS-P-15

Date: March 30, 1999

Action Items:

- 1) ~~FORGING LOCATION INCORRECT ON LAYOUT (ADJUST TO CORRECT LOCATION → REF - 03 LAYOUT)~~

Action Taken: *Correct it to the right position.*

- 2) ADJUST HEEL ANGLE TO ALLOW HEEL INSERT TO BE DRILLED ON "FLAT" SURFACE

Action Taken: *✓ did it.*

- 3) VERIFY 3D CLUSTER CLEARANCES.

Action Taken: *3D cluster clearance is checked, it is ok.*

- 4) ADD MILLING TO NO. 1 CONE "B" ROW (MILLES FLAT)

Action Taken: *Yes, did it.*

Action Taken:

- 5) ADJUST START ANGLES ON # 1E, 1F, 2E, 3C & 3E ROWS

Yes, changed.

Action Taken:

- 6) ADJUST HOLE DEPTH ON # 1E TO NON-STANDARD (HOLE DEPTH IS DEEPER THAN .280 SHOWN IN THE INSERT TABLE).

Action Taken: *No need anymore since changed flat heel.*

- 7) REMOVE RADIUS FROM CONE BACKFACE TO HEEL SURFACE TRANSITION.

Yes, did it.

Action Taken:

- 8) USE 510 GRADE ON 2D ROW (GAGE)

Yes, did it.

Action Taken:

Action Items Addressed:

Project Leader's Signature: *Yij Xij* Date: *4-12-99*

Peer Review

Project Information:

Page: 13

Title: 077mf15h

Number: CS-P-15

Date: March 30, 1999

Action Items:

- 9) CHANGE HEEL TO "FLAT" & "FLUSH" STYLE SIMILAR TO PREVIOUS C.R.'S (5630, 5680, 5743). USE $3/16"$ Ø IN #1 COVE (IF NECESSARY).

Action Taken:

Yes. did it.

- 10) INCREASE GROOVE RADIUS ON 2C-D GROOVES.

Yes. did it.

Action Taken:

Action Items Addressed:

Object Leader's Signature: X3 X2 Date: 4-12-99

CONFIDENTIAL << ER TEST PLAN >> FOR INTERNAL USE ONLY <<

Number: 5754		INCOMPLETE		04/13/99	Date Revised: 04/13/99
077	Type: MF15H	Mfr: STC	EO: 23482	Project: CS-P-15	Product Type: RDF
1:	BOM 2:	BOM 3:	Plant:	Project Engineer: YING XIANG	
FTR: NEW CUTTING STRUCTURE					

Description:

Cutting structure design based on ideas analysis tools. three gages rows on three cones are in the different locations, with different diameters, angles, and grades. The profile is very different from existing f15h bit.

ISSUED**APR 21 1999****ENGRG. HOUSTON**

Entered DRB Date: 00/00/00	Quantity of Runs for Rigorous Test Analysis:		
Origination Date: 00/00/00	PM Prioritization Date: 00/00/00	DDQP Date: 00/00/00	EO Completion Date: 00/00/00

DISTRIBUTION OF RIGOROUS TEST BITS

District Code	District Name	Est. Production	Quantity
		00/00/00	

DESIGN OVERVIEW**Needs Comments:**

ROP from reed 51x bit

Market Comments:

P51X and HP51XM

and Measures Comments:

market share of f15h bit, using ideas program as tool for new cutting structure development

CONFIDENTIAL <<**ER TEST PLAN****>> FOR INTERNAL USE ONLY <<****Location and Lithology Comments:**

try it first in the area where f15h standard bit drills softer formation, such as Canada, if the cutting struture holds itself, then it should be able to be used in other tough f15h bit area.

Drilling Practices and Conditions Comments:

f15h drilling practices should work for this bit

ISSUED**APR 21 1999****ENGRG. HOUSTON****SPECIFIC DESIGN CHANGES/FEATURES****Description of each Change or Feature:**

bit is total differet from our standard f15h bit in inserts counts, row counts.

Objective of each Change or Feature:

velop a bit which can compete with 51x without mud pick feature

FIELD ENGINEERING INSTRUCTIONS**Additional Parameters for ER Test Comments:**

as standard F15H and benchmark bits.

Reporting, Analysis, and Evaluation Requirement Comments:

conditions, wear resistance, and ROP are the most important for evaluation

Bit Return Requirement Comments:

n every bit to Houston for evaluation.

DESIGN REVIEW BOARD**al DRB Date: 00/00/00****DRB Results:****gn Review Board Comments:**

ISSUED

4.21.1999

IG. HOUSTON

ENGINEERING ORDER

Ponca

NO. 23482SHEET 1 OF 1

E.C.R. NO.

REQUESTED DATE: 4-20-99E.R. NO. 5754

<input type="checkbox"/> NEW PRODUCT	<input checked="" type="checkbox"/> NEW B.O.M. NO.	<input type="checkbox"/> B.O.M. CHANGE	<input type="checkbox"/> FORGING CHANGE
<input type="checkbox"/> NEW BEARING NO.	<input checked="" type="checkbox"/> NEW PART NO.	<input type="checkbox"/> PART CHANGE	<input type="checkbox"/> STATUS CHANGE
<input type="checkbox"/> NEW FORGING NO.	<input checked="" type="checkbox"/> NEW DWG. NO.	<input type="checkbox"/> DWG. CHANGE	<input checked="" type="checkbox"/> PRODUCT REDESIGN

SIZE / TYPE 077 MF154BEARING NO. 525-0580TITLE new MF154 type bit design. different from other F154 designs.PROJECT NO. CS-P-15

DESCRIPTION:

Create a new MF154 bit cutting structure (BOM 00244-98). Three gage rows on three cones are at the different locations. #1 cone uses set gage insert, two and three cones use RGs type inserts. New cone assemblies, and new cone profile & drilling are required. One new insert required (P/N 0024678), which is the same shape and dimension as part 0022626, but different grade. Finished bits are to be marked on the top of the pin and on the bit box as ER 5754, which uses as the bit type.

NEW	SUPERSEDES	OLD	NEW	SUPERSEDES	OLD
<u>0024398</u>					

REASON: Research development product

DISPOSITION OF AFFECTED PARTS:

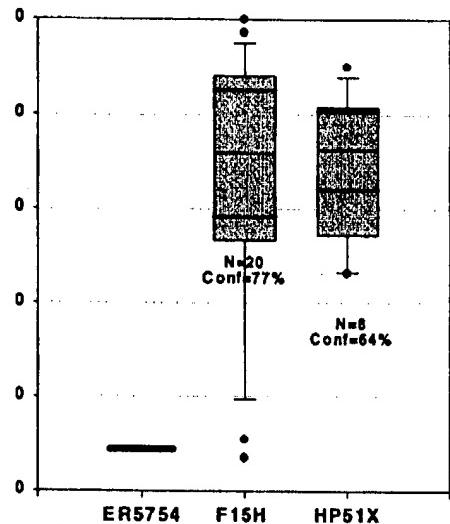
DRAWING NO.	REV. LTR.	DRAWING NO.	REV. LTR.	PART NO.	REV. LTR.	BOM AFFECTED	REV. LTR.	PREPARED BY:
#1 Assy		204326		0024679		0024598		<u>Bobby Daniel</u>
#2 Assy		204327		0024680				
#3 Assy		204328		0024681				
#1 P&D		204323						
#2 P&D		204324						
#3 P&D		204325						
Insert		0024678		0024678				

APPROVED BY:

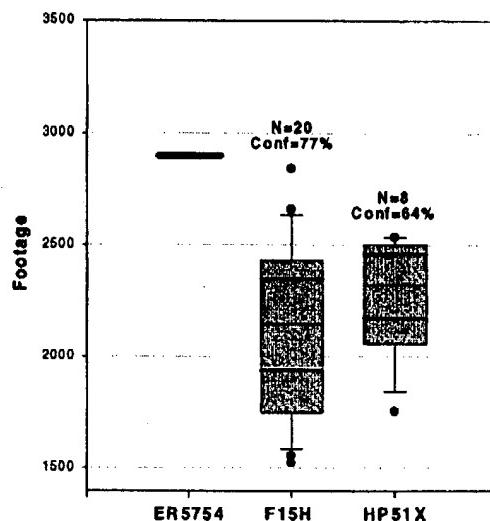
J. X. X.DATE: 4-20-99CONFIGURATION
MANAGEMENT:S. Schindler

11-71-99

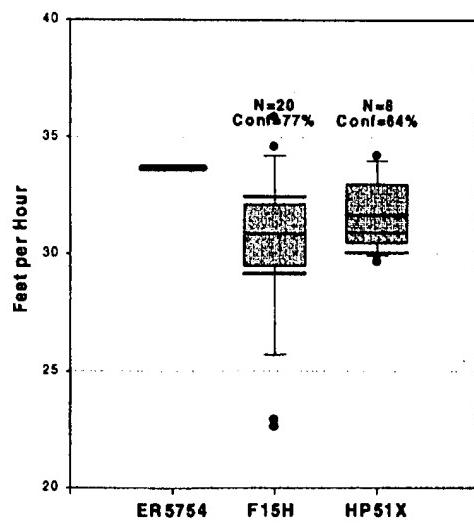
Depth In Comparison
ER5754 - LX4911



Footage Comparison
ER 5754 - LX4911



ROP Comparison
ER5754 - LX4911



ER5754

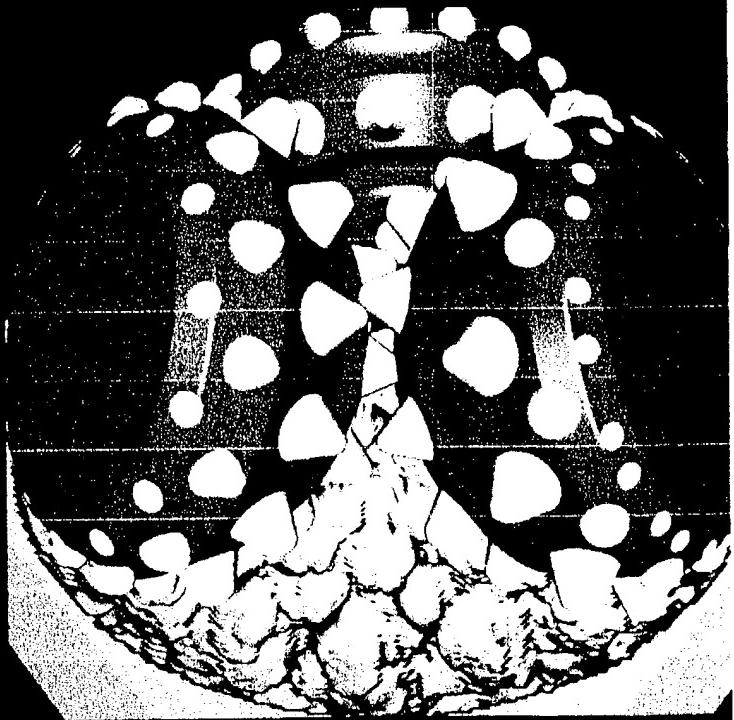
ER5754 came from a project named “HP51X killer” in 1999

THE FIRST IDEAS BIT

It was the first bit designed fully using IDEAS

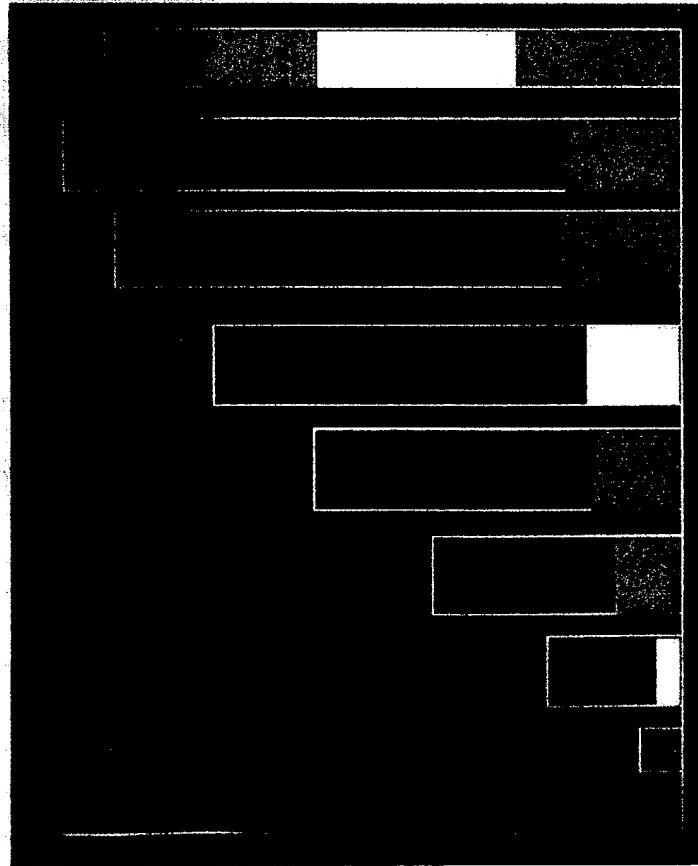
It hits homeruns in the fields of U.S. and Canada

It is also a HP53X killer



IDEASTM Bit Design: 7 7/8 ER 5754

Bottom Hole Coverage Pattern

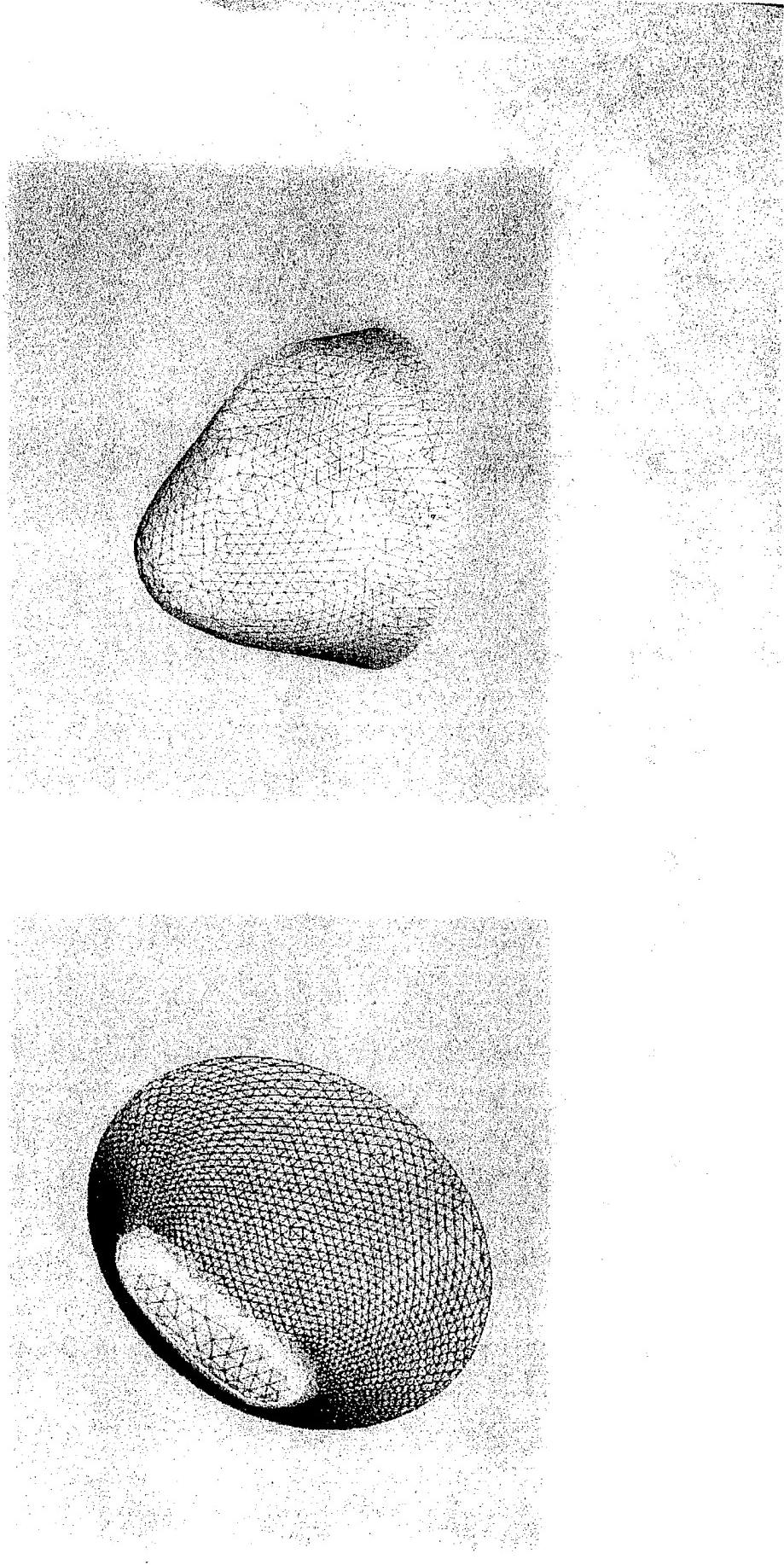


STD 7 7/8 F15H

ER 5754

Bit Optimization

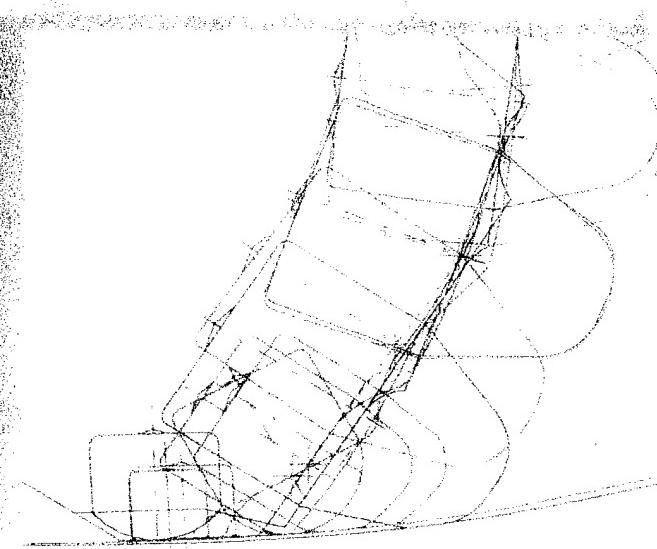
Insert Sharpness, Shape, Counts And Wear Resistance



IDEASTM Bit Design: 7 7/8 ER 5754

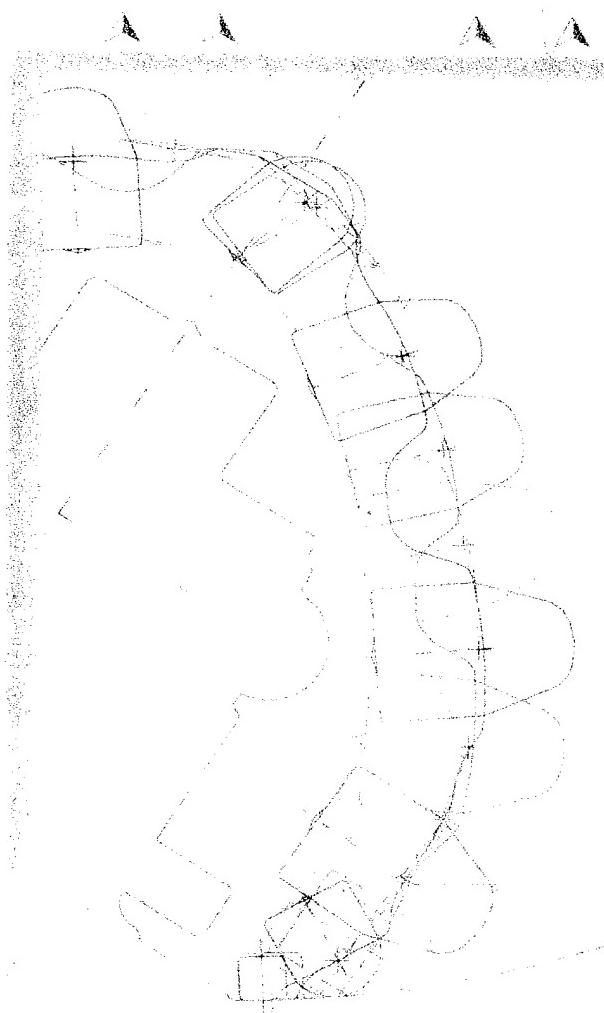
STD FISH ER 5754

WOB	42k
RPM	85
Rop/ideas	23.44
Rock Type	Shale
Bit Coverage	38%
Bit Offset	.188
Insert Count	104
Row Count	11
Insert Ext.	.37
	.38



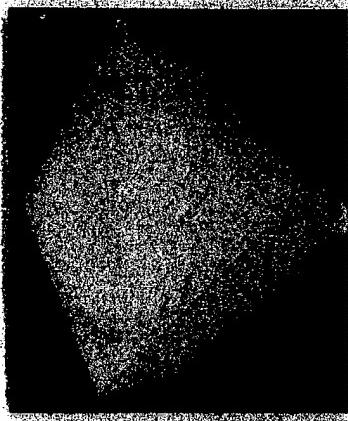
IDEAS™ Bit Design: 7 7/8 ER5754

- Increased bit offset .219 vs. .188
- Unique gage configuration
- Aggressive profile with increased bottom hole coverage
- Sharper inner row insert
- Balanced cone-bit ratios
- Vertical force balanced
- Bottom hole pattern optimization



Bit Optimization

- Profile design
- Bottom hole pattern
- Insert sharpness, shape, counts and wear resistance
- Gage inserts configuration and efficiency
- General bit geometry

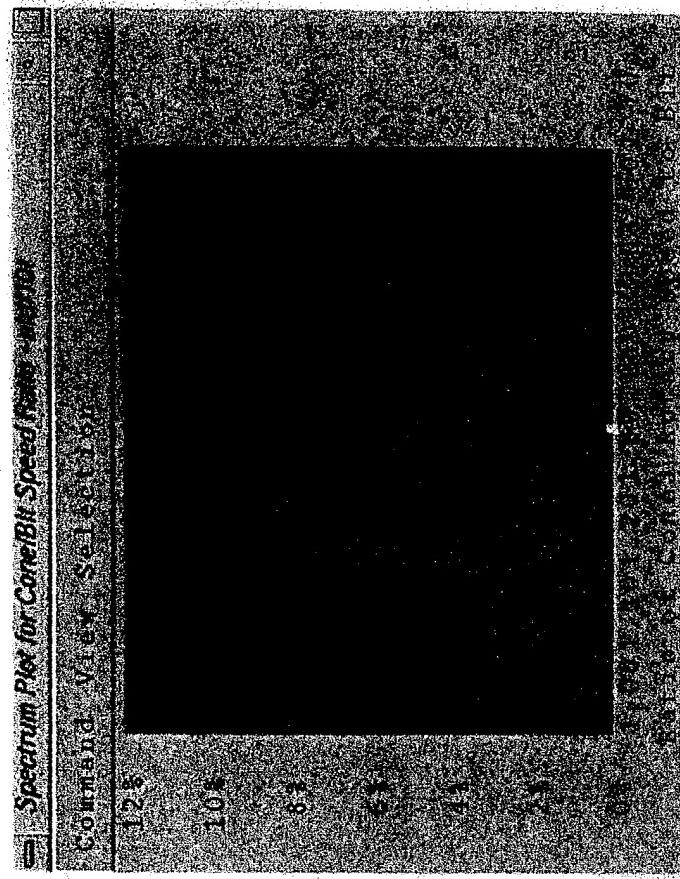
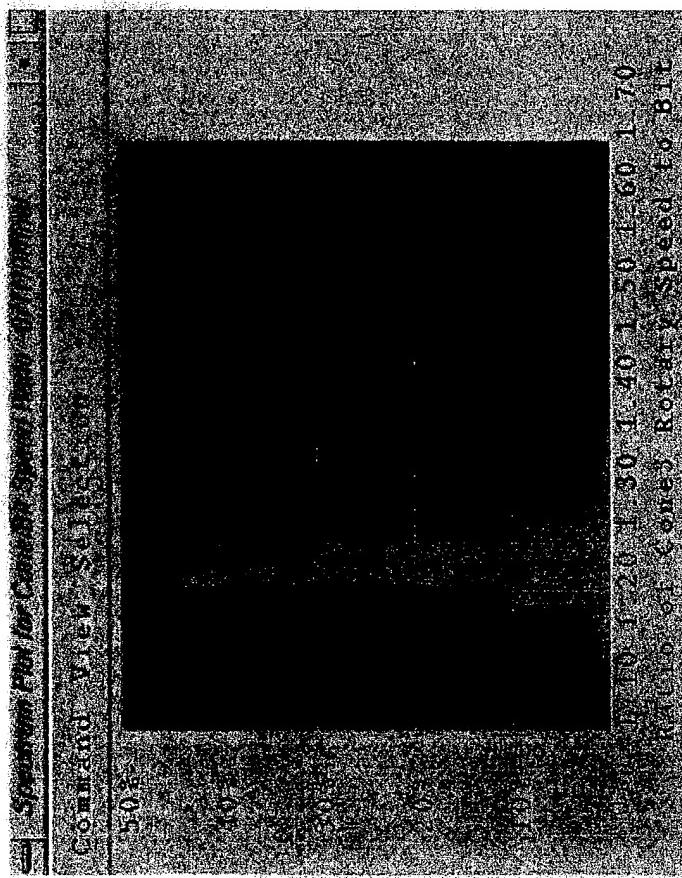


Bit Optimization

- Profile design
- Bottom hole Pattern
- Insert sharpness, shape, counts and wear resistance
- Gage inserts configuration and efficiency
- General bit geometry

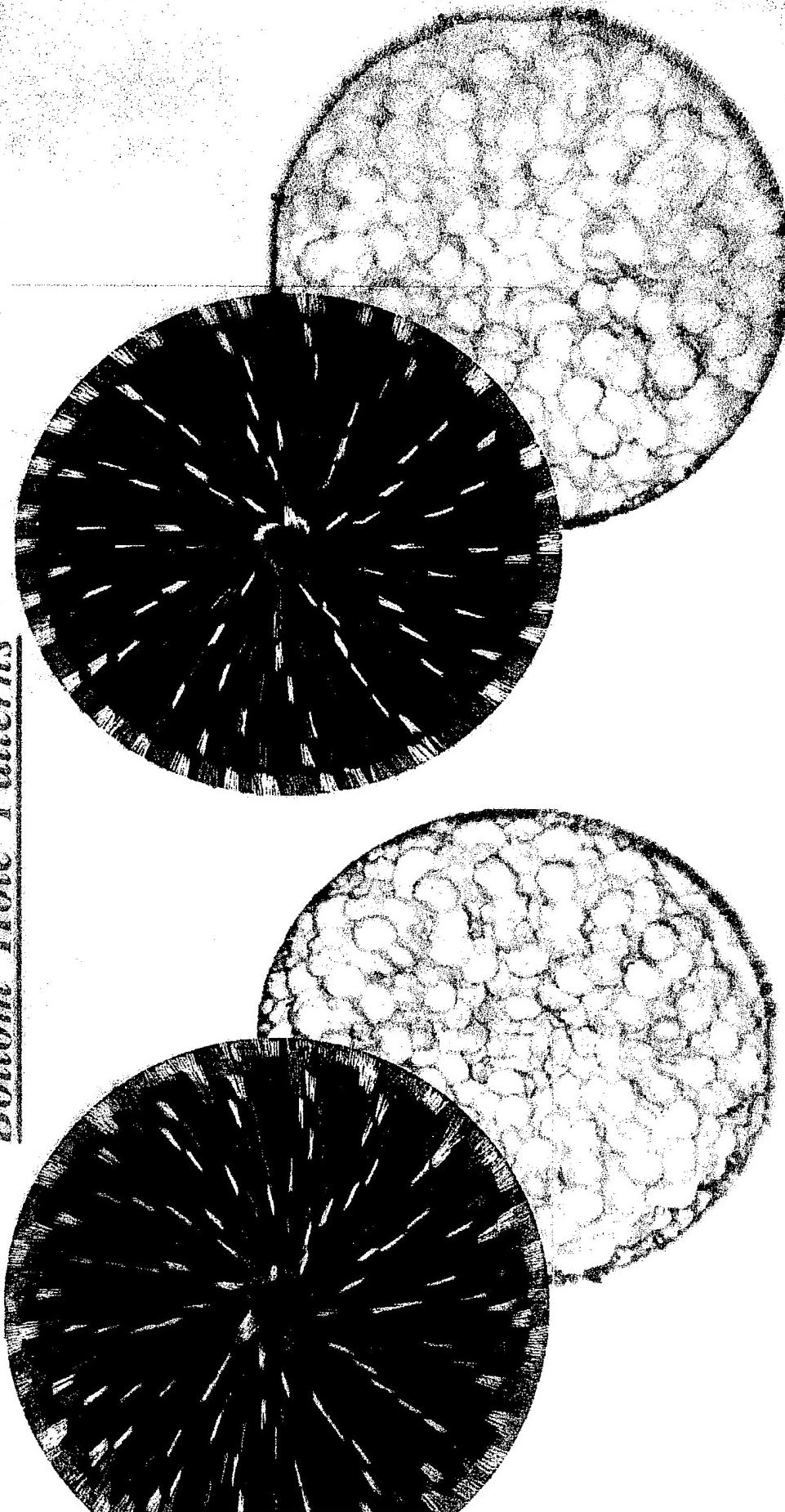
Bit Optimization

Bit/Cone Rotation Ratio



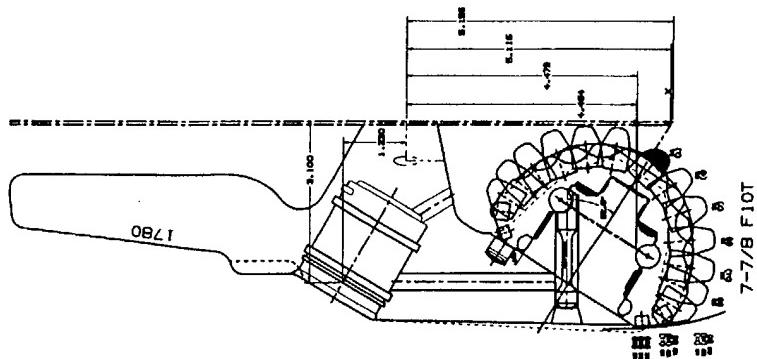
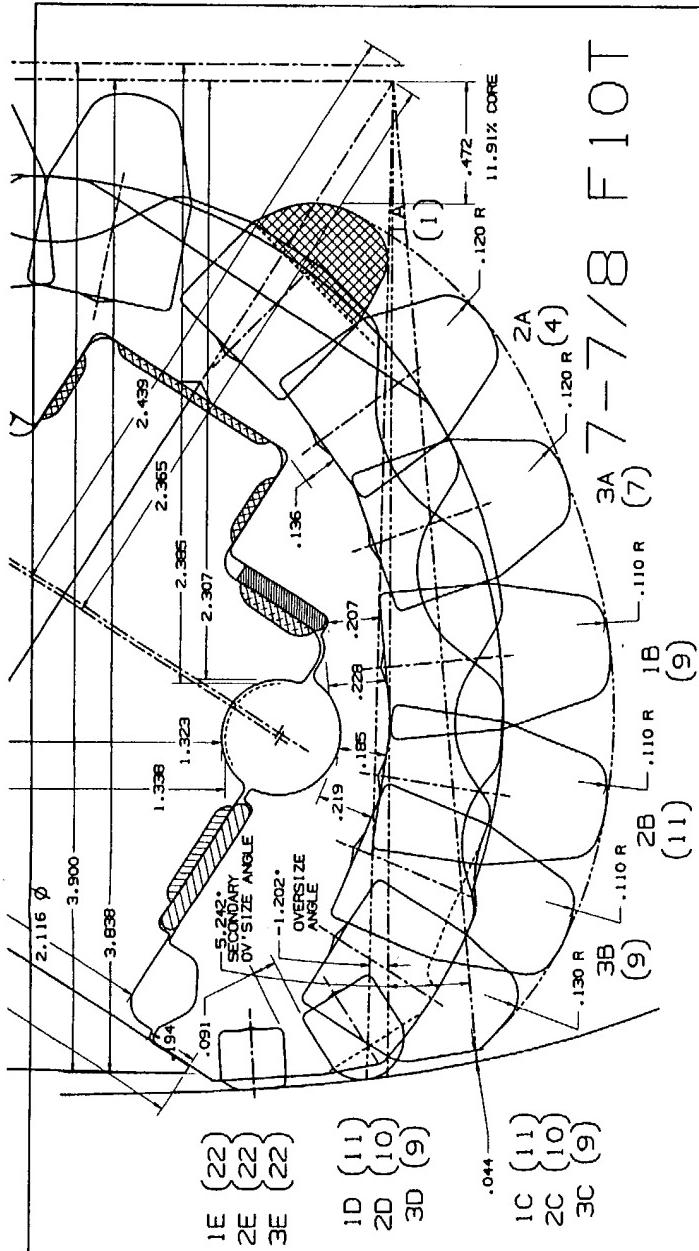
IDEAS™ Bit Design: 7 7/8 ER5754

Bottom Hole Patterns

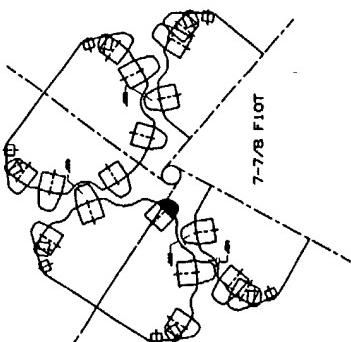


ER 5754

Standard 7 7/8 FISH



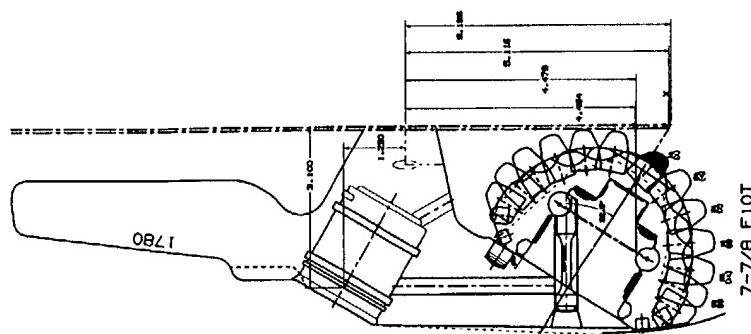
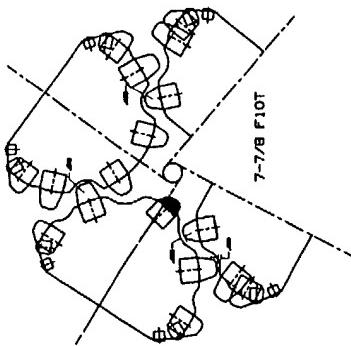
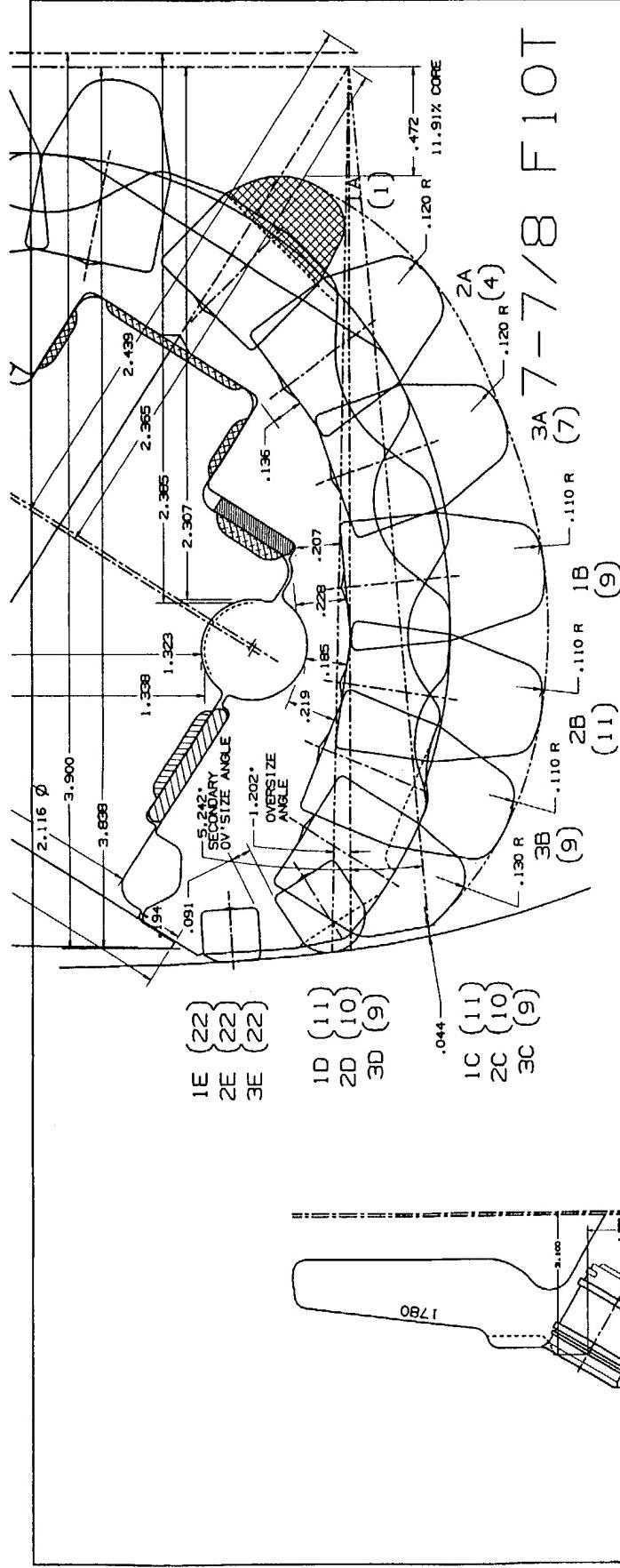
NAME		L		M		S		T		U		V		W		X		Y		Z		
NAME	NUMBER	L	M	S	T	U	V	W	X	Y	Z	NAME	NUMBER	L	M	S	T	U	V	W	NAME	NUMBER
A 1 1 COLUMBIA 300770	614	FBC	.5000	.100	.10	0	.000	.000	0	0	0	A 1 1 COLUMBIA 300770	614	FBC	.5000	.100	.10	0	0	0	A 1 1 COLUMBIA 300770	614
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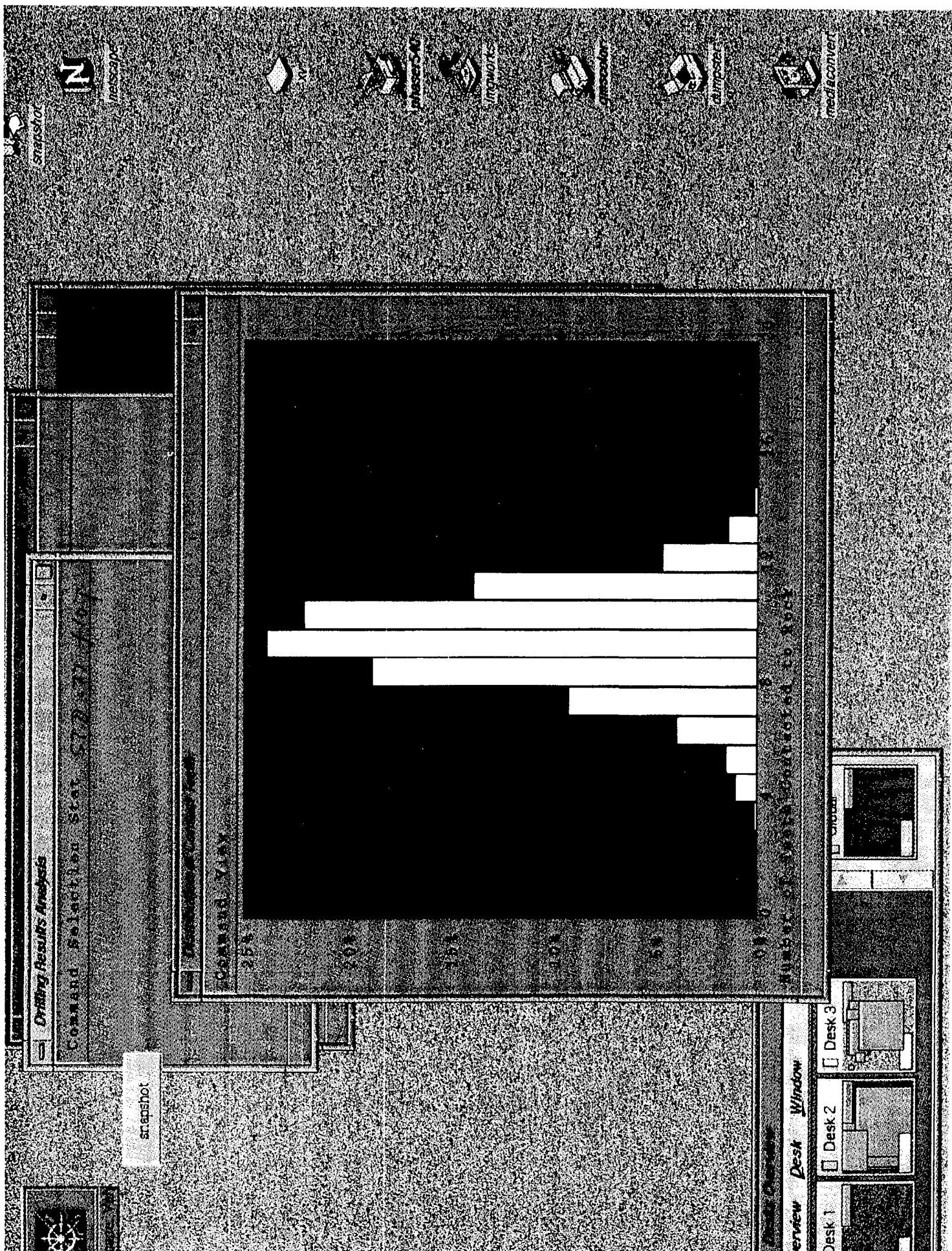
MILLING CUTTER			SPECIAL INSTRUCTIONS	
SIZE	SHANK DIAM.	SHANK L.	SIZE	SIZE
1/2"	1/2"	3"	37	5" X 7/8" D X 1/2" R
1/2"	1/2"	3"	36	5" X 7/8" D X 1/2" R
1/2"	1/2"	3"	35	5" X 7/8" D X 1/2" R

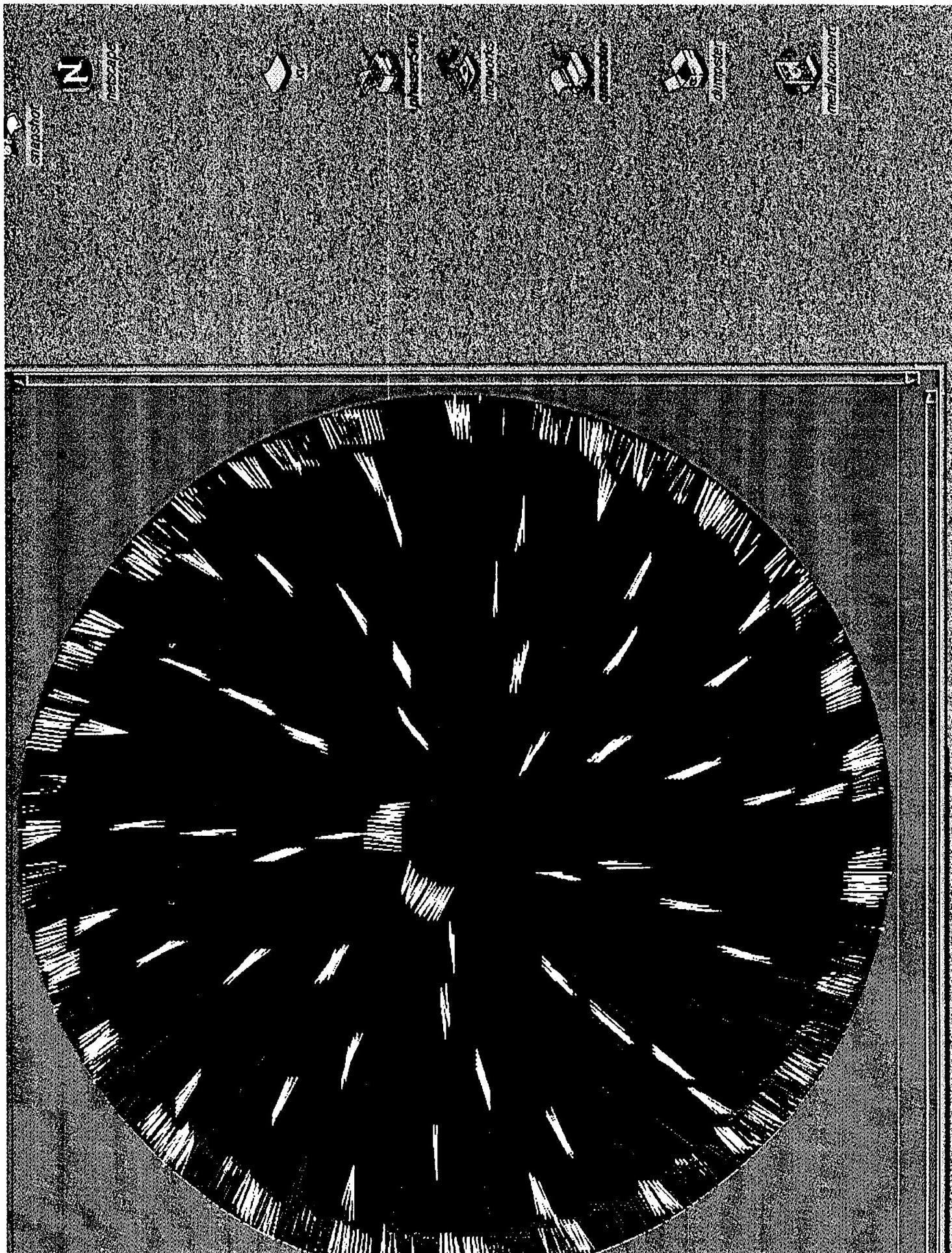
DRILL/MILL ENTITIES ARE CURRENT

ER#	USER ID	LAST NAME	FIRST NAME	MIDDLE	TOTAL INR.	INR/HR.	SHR/HR.	DRILL BY	SHR BY	DATE INR.	DATE SHR.
ERS681	CORE FLOWLINE	CORE	FLOWLINE		101.00	101.00	101.00	APPROVED BY	APPROVED BY	1-10	1-10
PD-P-0228	SEARCH NO.	SEARCH	SEARCH	SEARCH	101.00	101.00	101.00	CHIEF DRILLER	CHIEF DRILLER		
	JOURNAL	JOURNAL	JOURNAL	JOURNAL	101.00	101.00	101.00	HOLE SAW	HOLE SAW		
	OPPSET	OPPSET	OPPSET	OPPSET	101.00	101.00	101.00	SEAL CHAMFER	SEAL CHAMFER		
					11.14	11.14	11.14				
					L7077-F10T-02-P						



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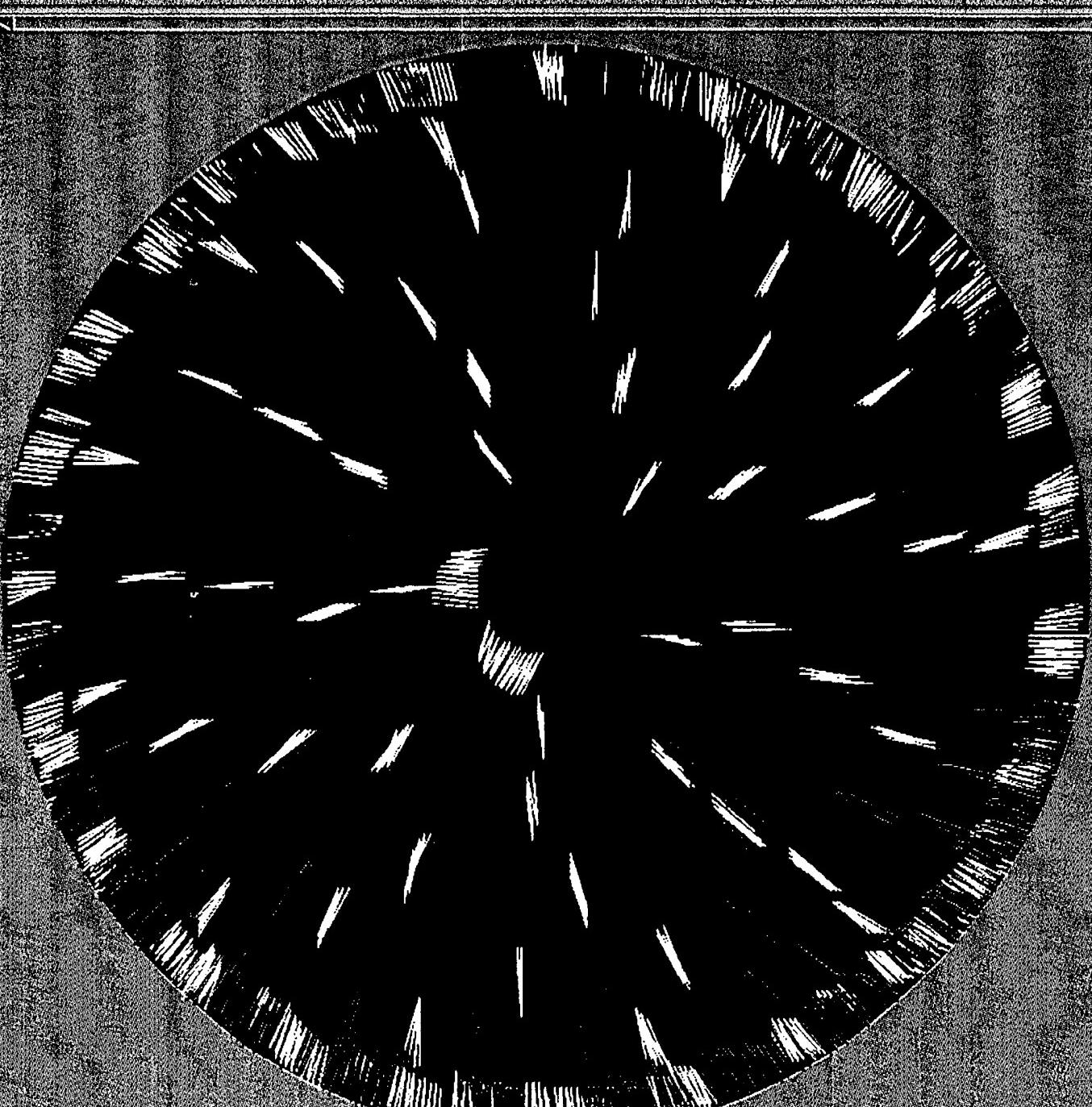
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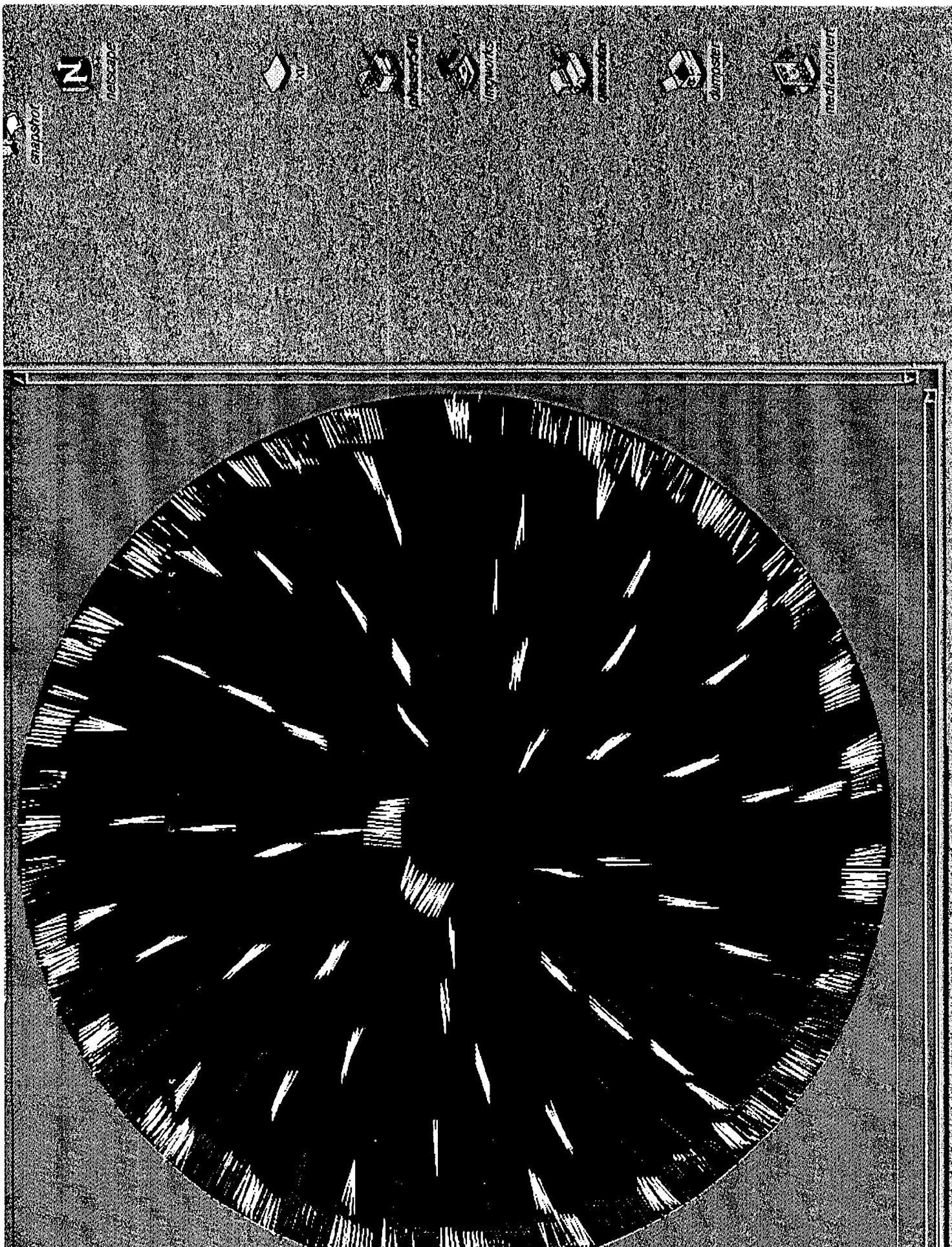
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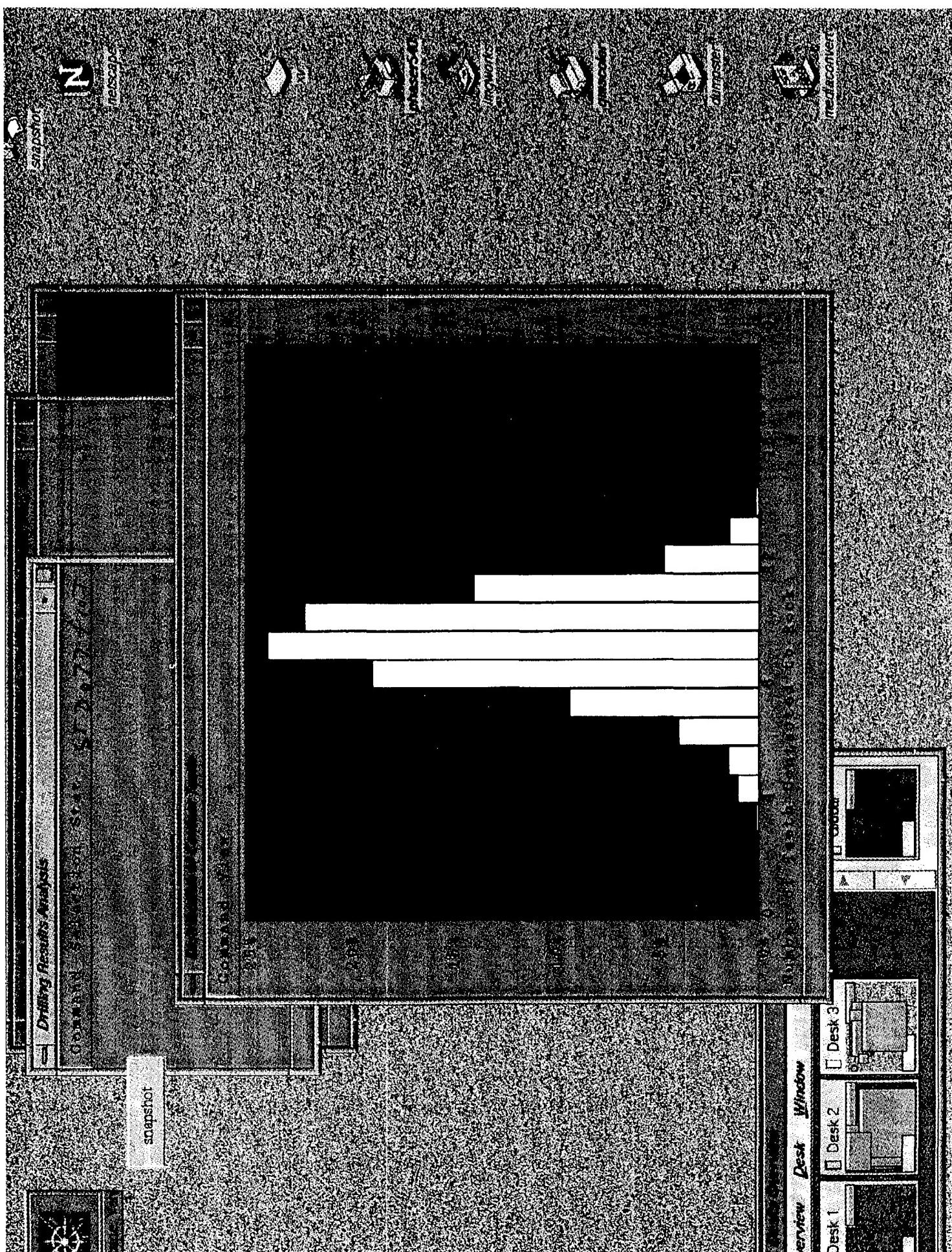


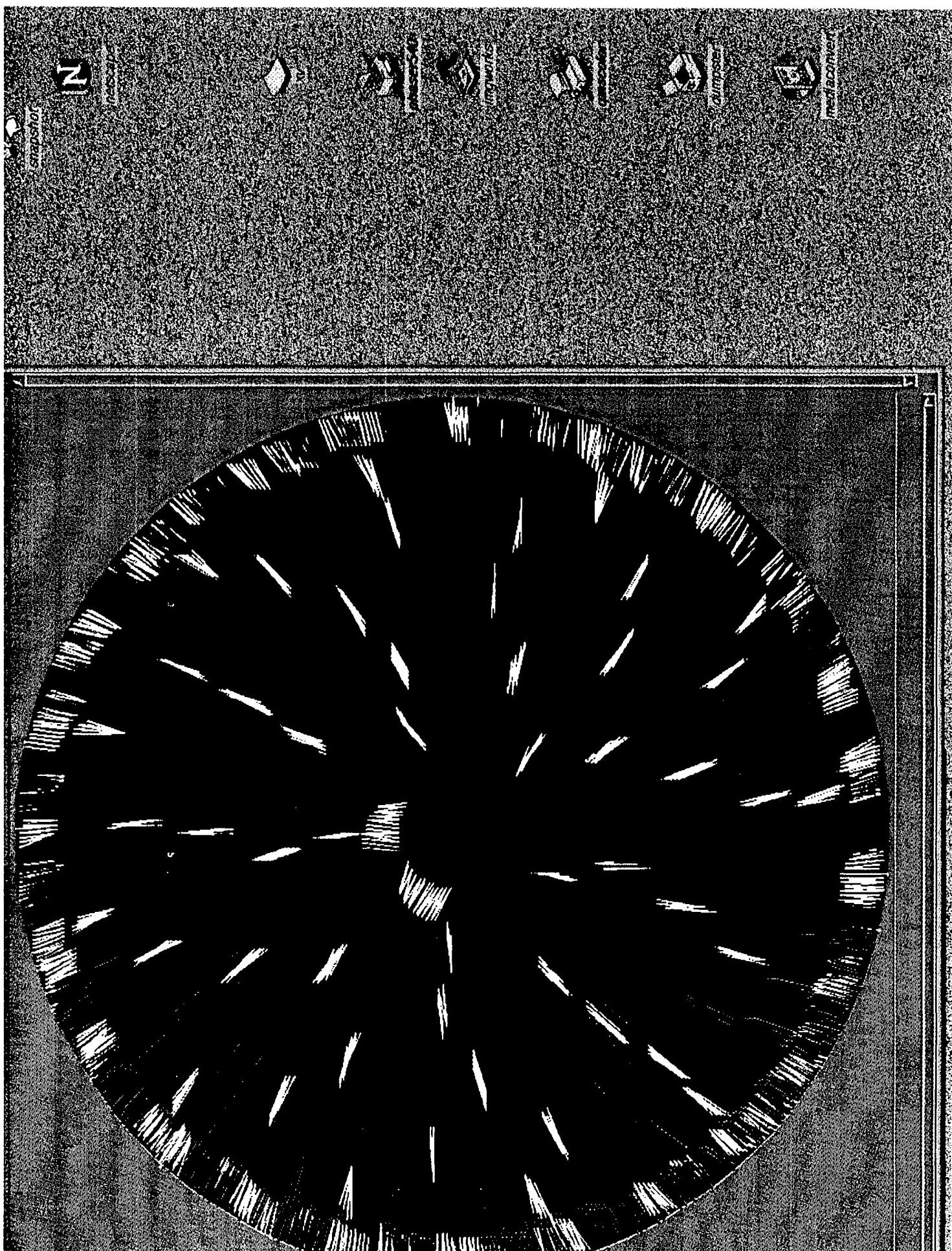
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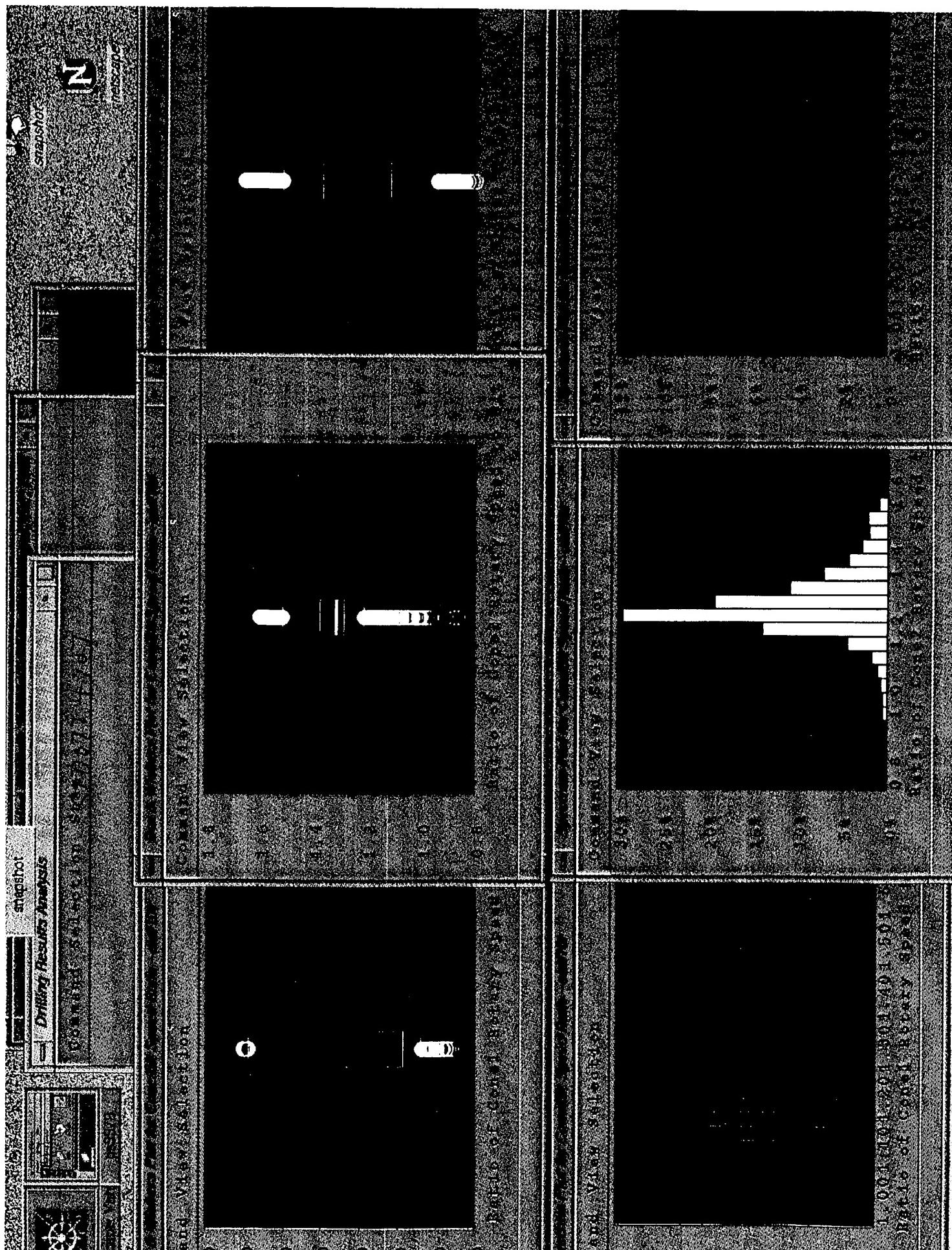
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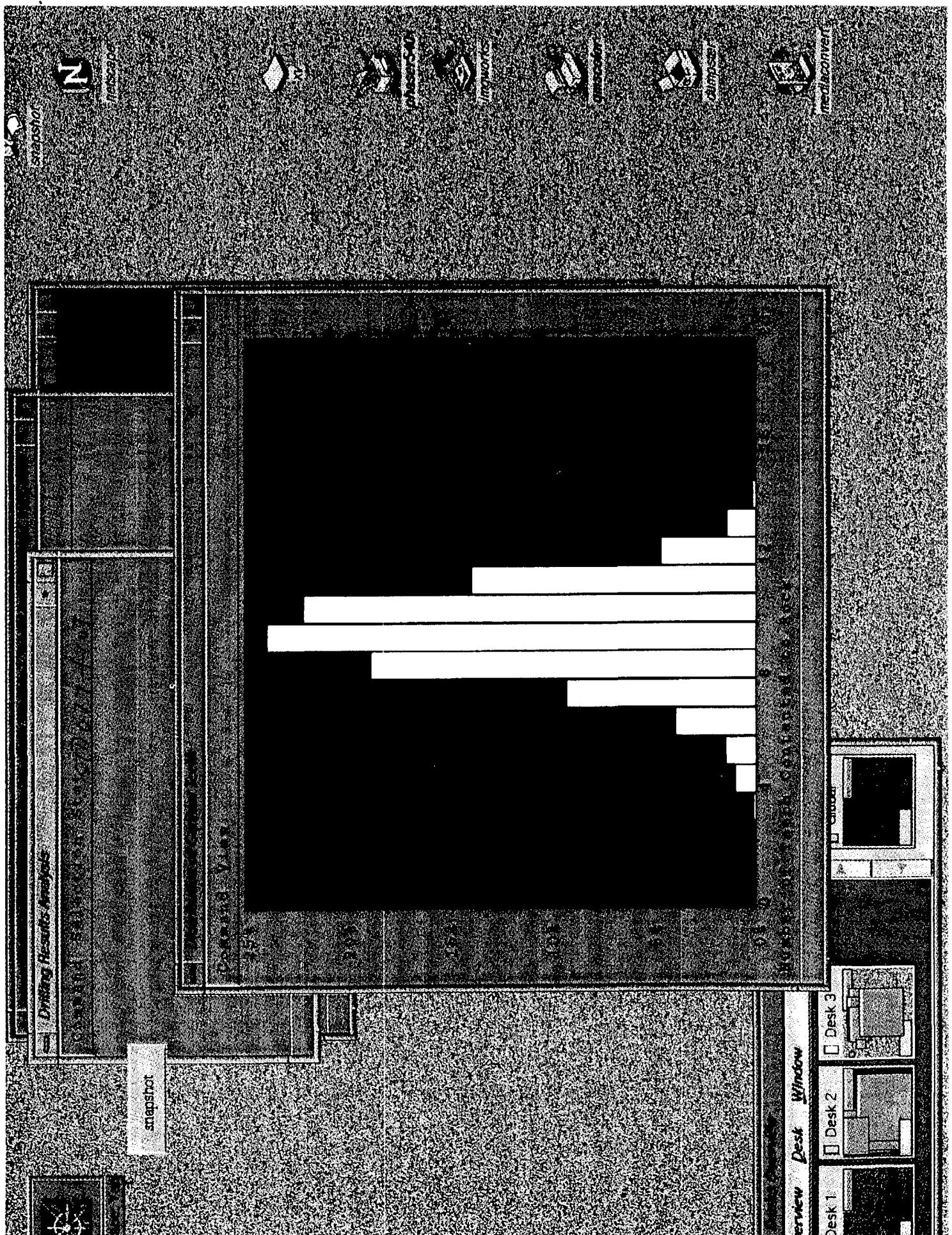


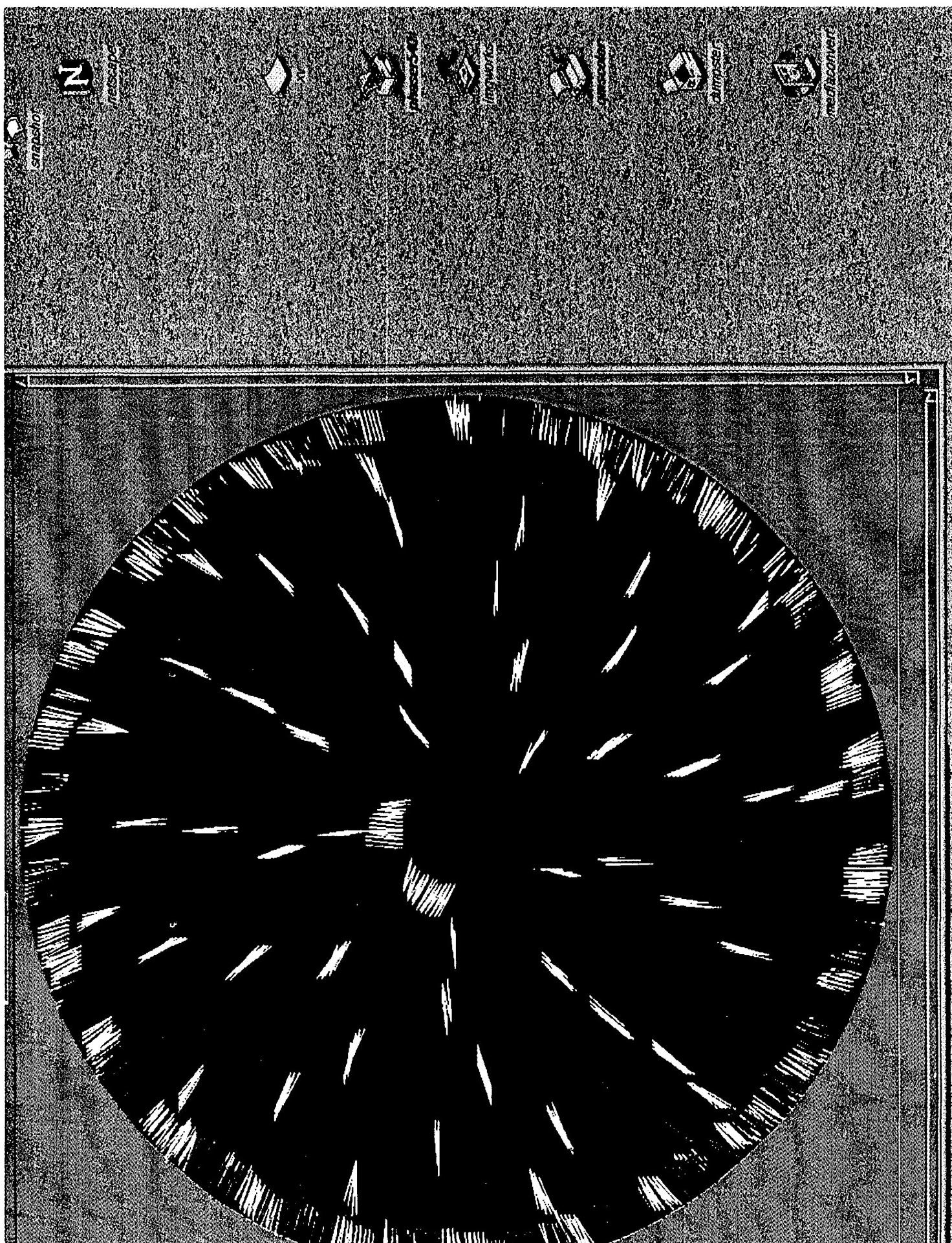












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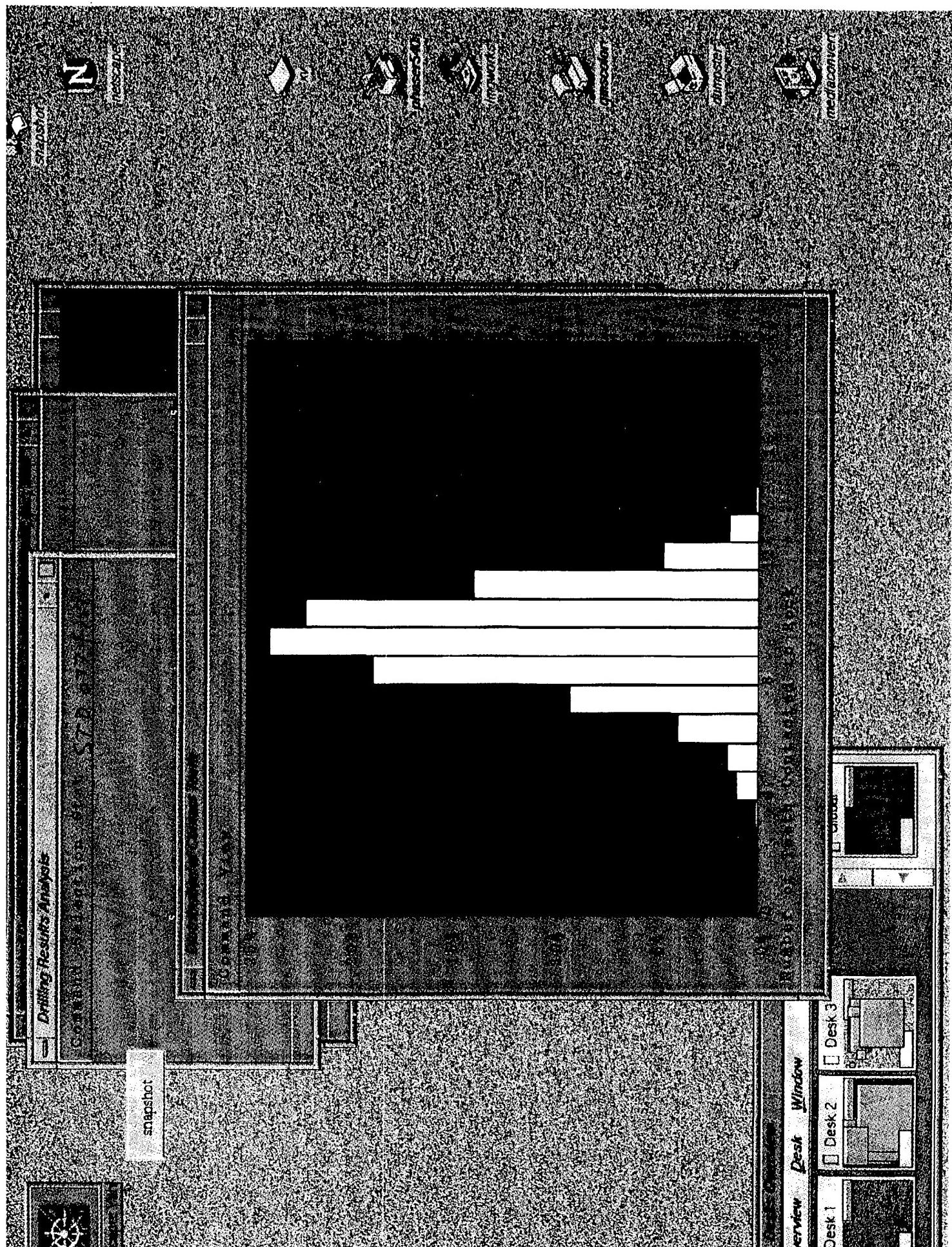
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IAS Calculation Summary

ject: /users/ps9978/projflot offsetflot
 meter of Bit: 7.87 (in) [200 (mm)]
 ght on Bit: 42000 (lbf) [19051 (kgf)]
 olutions per minute: 170 (rpm)
 olutions of Simulated: 30 (rev)
 fficient of Rock-shell contact: 1
 hole area: 48.707 (sq.in)

offset

.375

CutArea Coverage

(sq.in) %

21.29	43.70
16.90	34.69
17.62	36.17
18.42	37.82
18.69	38.38
19.16	39.34
18.78	38.55
20.28	41.63
19.38	39.78
19.55	40.15
19.25	39.52
19.68	40.41
17.85	36.66
19.17	39.36
19.07	39.16
18.16	37.29
18.46	37.91
19.47	39.97
17.41	35.74
19.70	40.44
20.02	41.10
18.61	38.20
17.42	35.77
18.70	38.39
17.05	35.00
19.61	40.25
19.62	40.28
19.37	39.77
19.82	40.68
19.88	40.81

range of Coverage for Bit: 38.90 %

range of Coverage for Each Row:

e	Row	Rmin (in)	Rmax (in)	C.Avr (sq.in)	CovI %	CovA %
1	3.852	3.937	0.002	0.07	0.00	
2	3.696	3.937	0.177	3.05	0.36	
3	3.162	3.937	1.950	11.28	4.00	
4	1.684	2.658	2.765	20.82	5.68	
5	0.232	0.896	0.186	7.91	0.38	
1	3.865	3.937	0.003	0.17	0.01	
2	3.716	3.937	0.150	2.83	0.31	
3	3.139	3.937	1.841	10.37	3.78	
4	2.299	3.277	3.582	20.91	7.35	
5	0.429	1.377	0.984	18.31	2.02	
1	3.865	3.937	0.002	0.09	0.00	
2	3.704	3.937	0.126	2.24	0.26	
3	3.154	3.936	2.060	11.83	4.23	
4	2.791	3.707	2.531	13.53	5.20	
5	1.122	1.996	2.060	24.07	4.23	

Penetration Depth 0.285 (ft) [87 (mm)]
 Average ROP 85.48 (ft/h) [26.05 (m/h)]
 Average Penetration Depth 0.253 (ft)
 Average ROP 86.13 (ft/h)

e	Row	Fz_max	Fz_median	Fz_aver	Counts	Angle
		27.921	9.409	9.789		
1	1	0.043	0.001	0.002	22	0.00
2	2	0.507	0.015	0.036	11	0.00
3	3	13.478	1.738	2.335	11	0.00
4	4	24.115	6.980	7.451	9	0.00
5	5	7.583	0.790	1.235	1	0.00
		33.017	15.419	15.681		
1	1	0.102	0.001	0.003	22	0.00
2	2	0.606	0.015	0.035	10	0.00
3	3	12.631	2.089	2.755	10	0.00
4	4	31.227	9.346	10.067	11	0.00
5	5	13.728	3.925	4.008	4	0.00
		30.458	15.388	15.383		
1	1	0.071	0.001	0.003	22	0.00
2	2	0.542	0.011	0.030	9	0.00
3	3	13.085	2.813	3.330	9	0.00
4	4	17.166	5.811	5.826	9	0.00
5	5	22.570	6.945	7.075	7	0.00
6	6	1.179	0.294	0.355	1	0.00

e	Row	Insert Forces	Fx_aver	Fy_aver	Fz_aver
1	1		0.110	0.004	0.002
2	2		0.631	0.041	0.025
3	3		0.728	0.118	1.457
4	4		0.210	0.074	5.501
5	5		0.134	0.238	1.238
1	1		0.104	0.005	0.003
2	2		0.598	0.037	0.027
3	3		0.582	0.117	1.837
4	4		0.183	0.066	6.462
5	5		0.196	0.047	3.720
1	1		0.122	0.006	0.003
2	2		0.585	0.036	0.025
3	3		0.488	0.119	2.367
4	4		0.122	0.097	4.923
5	5		0.189	0.075	5.552
6	6		0.042	0.161	0.359

Ratio of Cone Rotary Speed to Bit:

e Ratio
 1.2201
 1.3316
 1.3274

aping Brittle File Size 1476096 (bytes)
 tical Brittle File Size 13683936 (bytes)
 ll Contacted Times 2021 (times)
 tact Percentage of Shell to Rock 56.1389 %

IS Calculation Summary

ject: ././offsetf10t

meter of Bit: 7.87 (in) [200 (mm)]

ght on Bit: 42000 (lbf) [19051 (kgf)]

olutions per minute: 85 (rpm)

olutions of Simulated: 30 (rev)

fficient of Rock-shell contact: 1

hole area: 48.707 (sq.in)

CutArea Coverage

(sq.in) %

21.29 43.70

16.90 34.69

17.62 36.17

18.42 37.82

18.69 38.38

19.16 39.34

18.78 38.55

20.28 41.63

19.38 39.78

19.55 40.15

19.25 39.52

19.68 40.41

17.85 36.66

19.17 39.36

19.07 39.16

18.16 37.29

18.46 37.91

19.47 39.97

17.41 35.74

19.70 40.44

20.02 41.10

18.61 38.20

17.42 35.77

18.70 38.39

17.05 35.00

19.61 40.25

19.62 40.28

19.37 39.77

19.82 40.68

19.88 40.81

range of Coverage for Bit: 38.90 %

range of Coverage for Each Row:

Row	Rmin (in)	Rmax (in)	C.Avr (sq.in)	CovI %	CovA %
1	3.852	3.937	0.002	0.07	0.00
2	3.696	3.937	0.177	3.05	0.36
3	3.162	3.937	1.950	11.28	4.00
4	1.684	2.658	2.765	20.82	5.68
5	0.232	0.896	0.186	7.91	0.38
1	3.865	3.937	0.003	0.17	0.01
2	3.716	3.937	0.150	2.83	0.31
3	3.139	3.937	1.841	10.37	3.78
4	2.299	3.277	3.582	20.91	7.35
5	0.429	1.377	0.984	18.31	2.02
1	3.865	3.937	0.002	0.09	0.00
2	3.704	3.937	0.126	2.24	0.26
3	3.154	3.936	2.060	11.83	4.23
4	2.791	3.707	2.531	13.53	5.20
5	1.122	1.996	2.060	24.07	4.23
6	0.343	0.658	0.039	3.92	0.08

Penetration Depth 0.285 (ft) [87 (mm)]

ave fit ROP 42.74 (ft/h) [13.03 (m/h)]

range Penetration Depth 0.253 (ft)

range ROP 43.07 (ft/h)

#	Row	Fz_max	Fz_median	Fz_aver	Counts	Angle
		27.921	9.409	9.789		
1	1	0.043	0.001	0.002	22	0.00
2	2	0.507	0.015	0.036	11	0.00
3	3	13.478	1.738	2.335	11	0.00
4	4	24.115	6.980	7.451	9	0.00
5	5	7.583	0.790	1.235	1	0.00
		33.017	15.419	15.681		
1	1	0.102	0.001	0.003	22	0.00
2	2	0.606	0.015	0.035	10	0.00
3	3	12.631	2.089	2.755	10	0.00
4	4	31.227	9.346	10.067	11	0.00
5	5	13.728	3.925	4.008	4	0.00
		30.458	15.388	15.383		
1	1	0.071	0.001	0.003	22	0.00
2	2	0.542	0.011	0.030	9	0.00
3	3	13.085	2.813	3.330	9	0.00
4	4	17.166	5.811	5.826	9	0.00
5	5	22.570	6.945	7.075	7	0.00
6	6	1.179	0.294	0.355	1	0.00

#	Row	Insert Forces	Fx_aver	Fy_aver	Fz_aver
1	1		0.110	0.004	0.002
2	2		0.631	0.041	0.025
3	3		0.728	0.118	1.457
4	4		0.210	0.074	5.501
5	5		0.134	0.238	1.238
1	1		0.104	0.005	0.003
2	2		0.598	0.037	0.027
3	3		0.582	0.117	1.837
4	4		0.183	0.066	6.462
5	5		0.196	0.047	3.720
1	1		0.122	0.006	0.003
2	2		0.585	0.036	0.025
3	3		0.488	0.119	2.367
4	4		0.122	0.097	4.923
5	5		0.189	0.075	5.552
6	6		0.042	0.161	0.359

Ratio of Cone Rotary Speed to Bit:

Ratio

1.2201

1.3316

1.3274

apping Brittle File Size 1476096 (bytes)

tical Brittle File Size 13683936 (bytes)

ll Contacted Times 2021 (times)

tact Percentage of Shell to Rock 56.1389 %

Driving Point Analysis

snapshot

Desktop Selected Internet Find System CAD Handcopy Stuff Help

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DRIVING POINT ANALYSIS
DRIVING POINT ANALYSIS STATE

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Coarse View Selection

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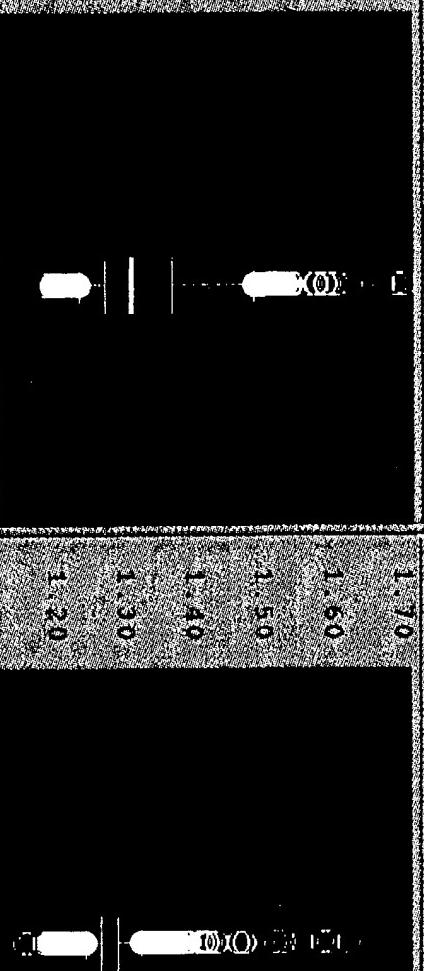
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Coarse View Selection

1.10 Ratio of cones to body speed

Coarse View Selection

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Coarse View Selection

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snapshot

Desktop Selected Internet Find System CAD Help Copy Staff Help

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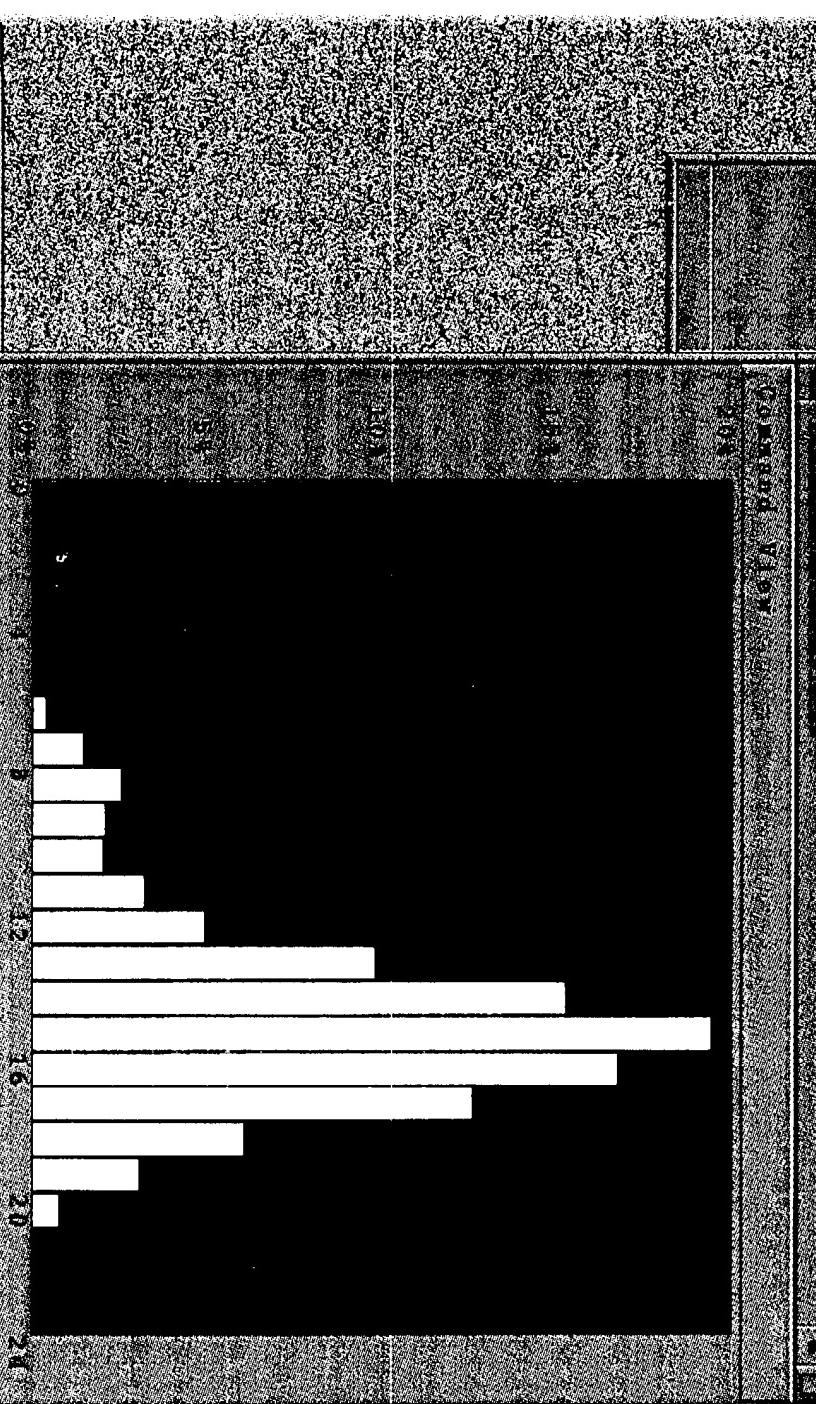


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Review Desk Window

Desk 1 Desk 2 Desk 3 Global

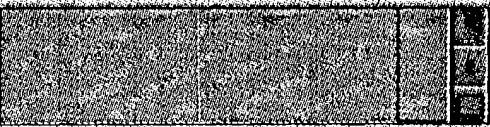
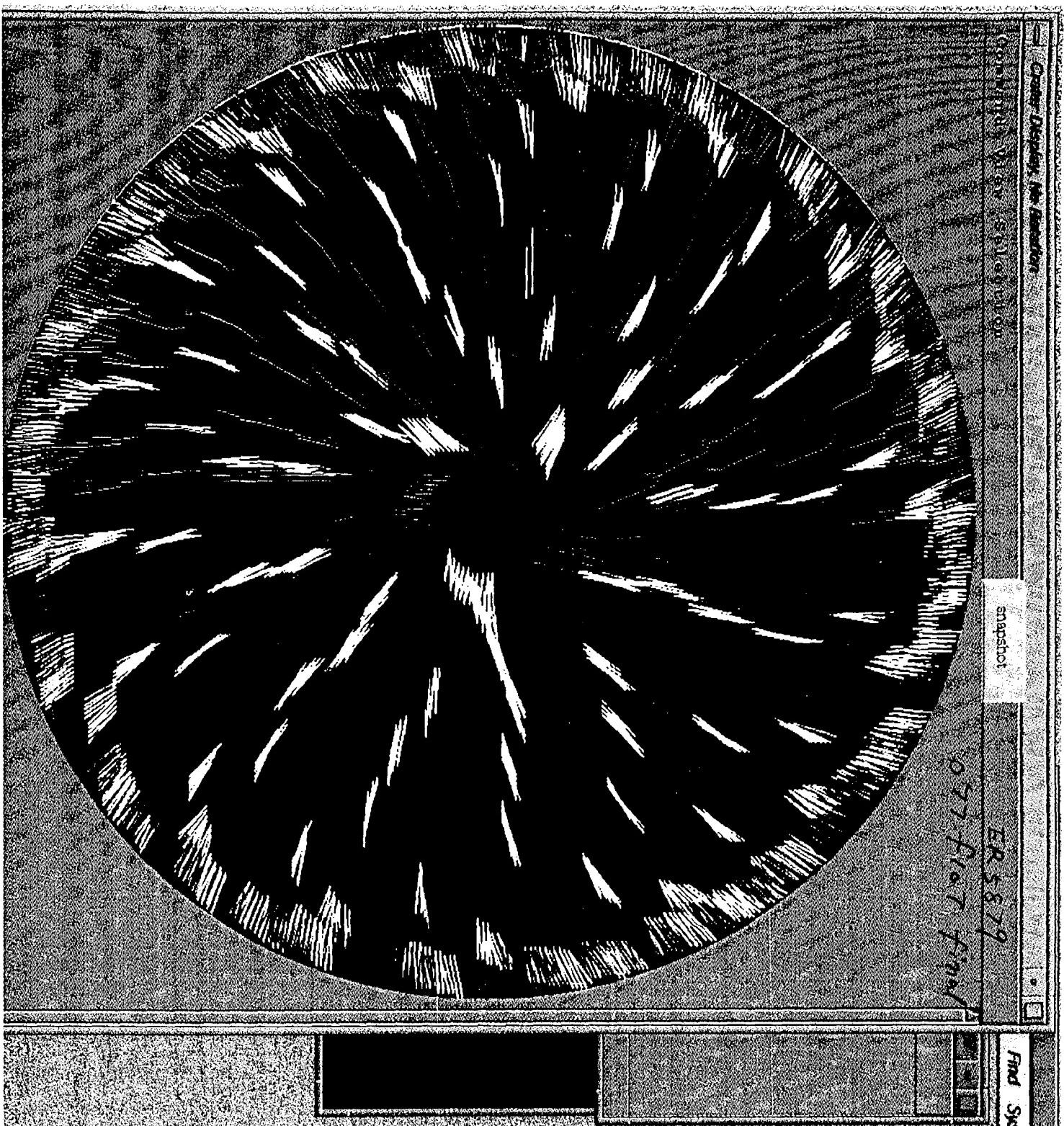


Computer Services Ltd.

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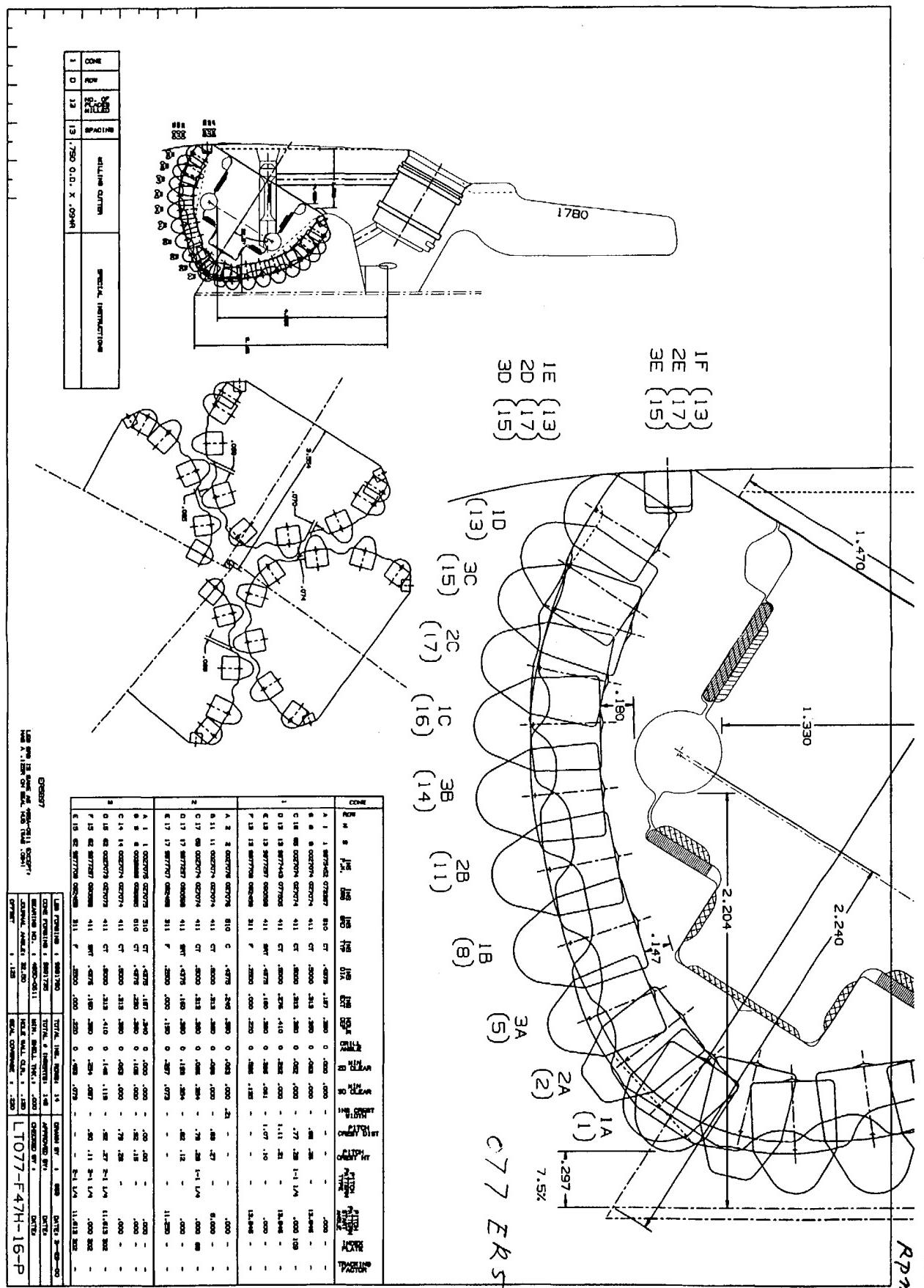
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snapshot



netscape



DRILL/MILL ENTITIES ARE CURRENT

Project Edit**Calculation**

Command Selection Stat

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Simulation

0.77 flow.maf

Snapshot

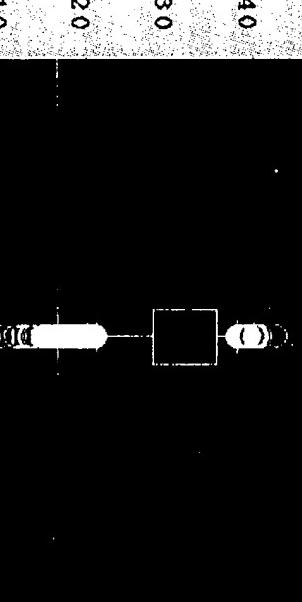


NetScape

Ratio of Cone1 Speed to Cone2 Speed

Command View Selection

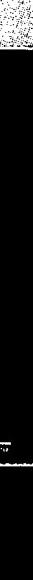
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**Ratio of Cone1 Rotary Speed**

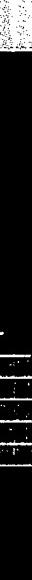
Command View Selection

**Ratio of Cone2 Speed to Cone3 Speed**

Command View Selection

**Ratio of Cone2 Rotary Speed**

Command View Selection

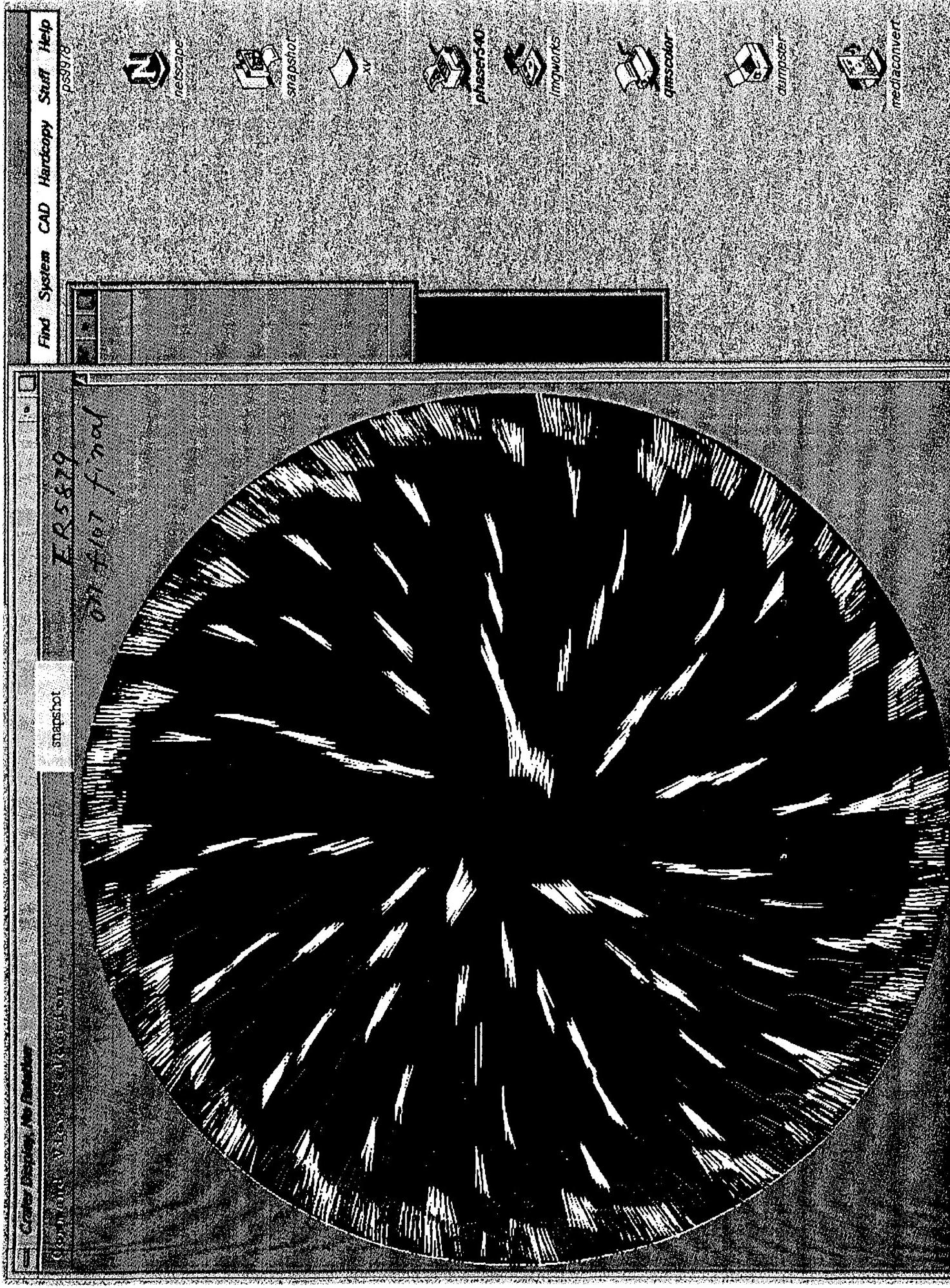
**Ratio of Cone3 Speed to Cone4 Speed**

Command View Selection

**Ratio of Cone3 Rotary Speed**

Command View Selection





Peer Review

Project Information:

Page: 1

Title: 077f10t

Number: cs-p-15

Leader(s): YING XIANG

Meeting Schedule:

Date: Feb. 10, 2000

Time: 9.00 a.m.

Place: room 2002

Meeting Objectives:

- 077 F10t cutting structure design review

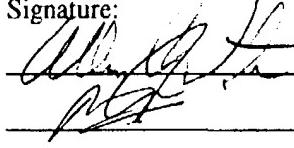
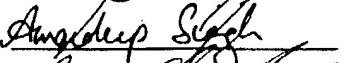
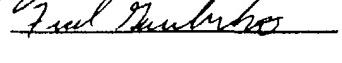
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Agenda Topics

Time Allotment

► Review Product Brief	<input checked="" type="checkbox"/> PDP	<input type="checkbox"/> ECR	<input type="checkbox"/> CAR	<input type="checkbox"/> EPA	⌚ 10
► information from the field					⌚ 10 min
► Review new design					⌚ 45 min
► open discuss					⌚ 15 min
►					⌚
►					⌚
► Recap Meeting and Action Items					⌚ 5 min

Invitees: (Attendance indicated by signature)

Name:	Signature:	Name:	Signature:
SCOTT McDONOUGH Karl Rose		ALLEN WATSON Prabakar Certala	
JIM MINIKUS			
AMAR SINGH			
IAN CHEVRETT			
red Gurbrecht			

Design Review Result:

Unconditional Approval
(No change required) Conditional Approval
(Action items must be completed) Another Design Review Required
(Redesign and conduct another design review)

Verification:

Manager/Supervisor Signature: _____ Date: _____

Peer Review

Project Information:**Page: 2**

Title: 077F10t

Number: CS-P-15

Date: Feb. 10, 2000

Action Items:

short the existing bearing sleeve. put bullet seal.
mud bug system on the hit.

Action Taken:

Name it fix in system
ER number for field.

Action Taken:

Action Items Addressed:

Project Leader's Signature: _____ Date: _____

SMITH TOOL

ENGINEERING ORDER

No.: 24017

Sheet 1 of 1
Location: PONCA

PROJECT/ECR NO.: CS-P-15	E.R. NO.: 5897
SIZE/TYPE: 077 F10T	BEARING NO.: 525-0540
TITLE: IDEALS BIT DESIGN	

DESCRIPTION:

CREATED A NEW BOM FOR 077 F10T TYPE BIT

BIT FEATURES:

- 1.) THIS NEW BIT CUTTING STRUCTURE IS DESIGNED TO GAIN HIGHER ROP - BETTER DULL CONDITION BY USING IDEALS SA CUTTING STRUCTURE ANALYSE TOOL.
- 2.) NO TRUE CUT FEATURE - ROW COUNT, INSERT COUNT ARE OPTIMIZED TO ACHIEVE HIGHER ROP.
- 3.) TWO NEW INNER ROW INSERTS - THREE DIFFERENT GAGE ROW INSERTS WITH DIFFERENT DIA. - DIFFERENT LOCATIONS ALONG GAGE CURVE.
- 4.) THIS BIT ALSO FEATURES A NEW BRG WITH BULLET SEAL SIMILAR TO BRG 525-0580.

ISSUED

MAR 08 2000

ENGRG. HOUSTON

PART #	REV.	DRAWING #	REV.	PART # SUPERCEDED	DRAWING # SUPERCEDED	DESCRIPTION
0026557						BOM FOR 077 F10T TYPE BIT NEW
0026848		205380				CONE 1 077 F10T ASSY NEW
0026849		205381				CONE 2 077 F10T ASSY NEW
0026850		205382				CONE 3 077 F10T ASSY NEW
		205376				CONE 1 077 F10T PROF. & DRILL NEW
		205377				CONE 2 077 F10T PROF. & DRILL NEW
		205378				CONE 3 077 F10T PROF. & DRILL NEW
		205388				CONE BRG DETL. NEW
0026854		205383				LEG MACH DETL. NEW
		205384				JRNL MACH DETL. NEW
		205385				JRNL FINISH DETL. NEW
		205386				LEG REMILL DETL. NEW
		205389				SHALE BURN INSERT DETL. NEW
0026855		D0026855				AG PLT. SPINODL BRG SLV NEW
0026445		D0026445				TCI SRCVSB 1/2 DIA./.380GP/.320EXT. NEW
0026289		D0026389				TCI SRCVSB 9/16 DIA./.410GP/.430EXT. NEW

REASON: PRODUCT MANAGER'S REQUEST

POSITION OF AFFECTED PARTS: N/A

Prepared By: <i>LEONARD WRIGHT</i>	Approved By: <i>GARY GARCIA</i>	Date: 08 MAR 00	Configuration Mgmt.: <i>S Schindler</i>	Date: 3-8-00
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Smith International
Smith Tool

*** PONCA CITY ***
Indented Bill of Material Report

Date: 08-MAR-00
Page: 1

Item: 0026557 Size: 077 Type: F10T Features:
ER: 5879 IADC: 437X Pin Size: 4 1/2 BRG #: 525 - -0540
Rev: -- EO: 24017 Status: E Rev Date: 06-MAR-00

Item Description: 077 F10T ER5879 2312 FPD/AG BRG/SF IADC 437X

LEVEL	COMPONENT	REV	DESCRIPTION	QUANTITY	UOM
1	0026848	--	1 CONE 077 F10T ASSEMBLY	1.000	EA
2	D205380	--	DWG 1 CONE 077 F10T ASSEMBLY		
2	D205376	--	DWG 1 CONE 077 F10T PROF & DRILL		
2	0009874	D	SRTC TCI 1/2 FB .203 EXT/.470 GP/GR 411H	1.000	EA
3	D0009874	--	DWG SRTC TCI 1/2 FB.203 EXT		
3	3-1	-	SPEC TUNGSTEN CARBIDE INSERTS		EA
3	50-6 (S)	-	SPEC TUNGSTEN CARBIDE INSERTS		EA
2	0026445	--	SCRVB TCI 1/2 FB .320 EXT/.380 GP/GR 614	9.000	EA
3	D0026445	--	DWG SCRVB TCI 1/2 FB .320 EXT		
3	3-1	-	SPEC TUNGSTEN CARBIDE INSERTS		EA
3	50-6 (S)	-	SPEC TUNGSTEN CARBIDE INSERTS		EA
2	0026289	--	SCRVB TCI 9/16 FB.430 EXT/.410 GP/GR 614H	14.000	EA
3	D0026289	--	DWG SCRVB TCI 9/16 FB .430 EXT		
3	3-1	-	SPEC TUNGSTEN CARBIDE INSERTS		EA
3	50-6 (S)	-	SPEC TUNGSTEN CARBIDE INSERTS		EA
2	0022626	--	RGCSS TCI 13/32FB .230 EXT .310 GP/GR 510H	18.000	EA
3	D0022626	--	DWG RGCSS TCI 13/32 FB .230 EXT		
3	3-1	-	SPEC TUNGSTEN CARBIDE INSERTS		EA
3	50-6 (S)	-	SPEC TUNGSTEN CARBIDE INSERTS		EA
2	9977707	A	F TCI 1/4 FB .000 EXT/.190 GP/GR 311	18.000	EA
3	D9977707	--	DWG F TCI 1/4 FB.000 EXT		
3	3-1	-	SPEC TUNGSTEN CARBIDE INSERTS		EA
3	50-6 (S)	-	SPEC TUNGSTEN CARBIDE INSERTS		EA
2	D093412	-	CONE CARB DTL		
2	D205388	--	CONE BRG DTL		
2	0026849	--	2 CONE 077 F10T ASSEMBLY	1.000	EA
2	D205381	--	DWG 2 CONE 077 F10T ASSEMBLY		
2	D205377	--	DWG 2 CONE 077 F10T PROF & DRILL		
2	0000231	-	C TCI 7/16 FB .204 EXT/.410 GP/GR 510H	2.000	EA
3	D092765	-	MAIN ENGR DRAW		
2	0026289	--	SCRVB TCI 9/16 FB.430 EXT/.410 GP/GR 614H	25.000	EA
3	D0026289	--	DWG SCRVB TCI 9/16 FB .430 EXT		
3	3-1	-	SPEC TUNGSTEN CARBIDE INSERTS		EA
3	50-6 (S)	-	SPEC TUNGSTEN CARBIDE INSERTS		EA
2	0018265	--	RGCSS TCI 3/8 FB .200 EXT .310 GP/GR411	15.000	EA
3	D0018265	--	DWG RGC TCI 3/8 FB .200 EXT.		
3	3-1	-	SPEC TUNGSTEN CARBIDE INSERTS		EA
3	50-6 (S)	-	SPEC TUNGSTEN CARBIDE INSERTS		EA
2	9977707	A	F TCI 1/4 FB .000 EXT/.190 GP/GR 311	15.000	EA
3	D9977707	--	DWG F TCI 1/4 FB.000 EXT		
3	3-1	-	SPEC TUNGSTEN CARBIDE INSERTS		EA
3	50-6 (S)	-	SPEC TUNGSTEN CARBIDE INSERTS		EA
2	D093412	-	CONE CARB DTL		
2	D205388	--	CONE BRG DTL		
2	0026850	--	3 CONE 077 F10T ASSEMBLY	1.000	EA
2	D205382	--	DWG 3 CONE 077 F10T ASSEMBLY		
2	D205378	--	DWG 3 CONE 077 F10T PROF & DRILL		
2	9977315	C	SRTC TCI 7/16 FB .190 EXT/.360 GP/GR 411H	1.000	EA
3	D9977315	--	DWG SRTC TCI 7/16 FB.190 EXT		

Smith International *** PONCA CITY *** Date: 08-MAR-00
 Smith Tool Indented Bill of Material Report Page: 2

Item: 0026557 Size: 077 Type: F10T Features:
 ER: 5879 IADC: 437X Pin Size: 4 1/2 BRG #: 525 - -0540
 Rev: -- EO: 24017 Status: E Rev Date: 06-MAR-00

Item Description: 077 F10T ER5879 2312 FPD/AG BRG/SF IADC 437X

LEVEL	COMPONENT	REV	DESCRIPTION	QUANTITY	UOM
3	3-17315	-	SPEC TUNGSTEN CARBIDE INSERTS		EA
3	50-6(S)	-	SPEC TUNGSTEN CARBIDE INSERTS		EA
2	0026445	--	SCRVB TCI 1/2 FB .320 EXT/.380 GP/GR 614	5.000	EA
3	D0026445	--	DWG SCRVB TCI 1/2 FB .320 EXT		
3	3-1	-	SPEC TUNGSTEN CARBIDE INSERTS		EA
3	50-6(S)	-	SPEC TUNGSTEN CARBIDE INSERTS		EA
2	0026289	--	SCRVB TCI 9/16 FB .430 EXT/.410 GP/GR 614H	13.000	EA
3	D0026289	--	DWG SCRVB TCI 9/16 FB .430 EXT		
3	3-1	-	SPEC TUNGSTEN CARBIDE INSERTS		EA
3	50-6(S)	-	SPEC TUNGSTEN CARBIDE INSERTS		EA
2	0023857	--	RGCSS TCI 7/16FB .250 EXT .310 GP/GR 510H	18.000	EA
3	D0023857	--	DWG RGCSS TCI 7/16 FB .250 EXT		
3	3-1	-	SPEC TUNGSTEN CARBIDE INSERTS		EA
3	50-6(S)	-	SPEC TUNGSTEN CARBIDE INSERTS		EA
2	9977707	A	F TCI 1/4 FB .000 EXT/.190 GP/GR 311	18.000	EA
3	D9977707	--	DWG F TCI 1/4 FB.000 EXT		
3	3-1	-	SPEC TUNGSTEN CARBIDE INSERTS		EA
3	50-6(S)	-	SPEC TUNGSTEN CARBIDE INSERTS		EA
2	D093412	-	CONE CARB DTL		
2	D205388	--	CONE BRG DTL		
	0026854	--	LEG 077 OSVB/32.5 JRNL/.312 OFFSET/2.360-C	3.000	EA
2	D205383	--	DWG LEG 077 F10T DOMEVENT W/SHALE GROOVE		
2	9991780	A	LEG FORG/OSVB 073-077 FTCI/FMT (4815)	3.000	EA
3	D087651	D	LEG FORG/OSVB		
3	D087656	B	LEG FORGE INSP		
2	9860104	-	HC-1 HARDMETAL	0.309	LB
2	9860427	-	HARDMETAL ROD ST-70M	0.027	LB
2	9976500	B	F TCI 7/16 OD 9/32GP/GR 311/.015 CHAMF	3.000	EA
3	D081257	B	DWG F TCI 7/16 OD		
2	0024824	--	1/4 FLAT SHALE BURN PLUG	3.000	EA
3	D0024824	--	DWG. 1/4 FLAT SHALE BURN PLUG		
2	D099548	B	LEG PAINT OFF		
2	D098790	F	RSVR DETAIL		
2	D089087	A	JET CIRC DETAIL		
2	D203413	--	LEG MILLING DTL		
2	D205385	--	JRNL FINISH DTL		
2	D205384	--	JRNL MACH DTL		
2	D205386	--	LEG REMILL DTL		
2	D205389	--	SHALE BURN INSERT ASSY		
	9977347	B	BHP 7/16 DIA 2.17 LG - .110 LIP	3.000	EA
2	D090795	L	DWG BHP		
2	9970531	B	7/16 DIA BALL	42.000	EA
2	D0024795	B	DWG BALL BEARING		
2	50-6(B)	-	SPEC - 50-6(B)		EA
	0026855	--	AG PLT/SPIN.BRG.SLV 1.9935ID X.070 X .540	3.000	EA
2	D0026855	--	DWG SILVER SPINODL BRG SLV (PRO-E)		
	0018415	A	BULLET SEAL 077-084	3.000	EA
2	D200502	A	DWG BULLET SEAL		
	0021740	A	077 - 097 DOMEVENT II RSVR ASSY	3.000	EA

Smith International
Smith Tool

*** PONCA CITY ***
Indented Bill of Material Report

Date: 08-MAR-00
Page: 3

Item: 0026557 Size: 077 Type: F10T Features:
ER: 5879 IADC: 437X Pin Size: 4 1/2 BRG #: 525 - - 0540
Rev: -- EO: 24017 Status: E Rev Date: 06-MAR-00

Item Description: 077 F10T ER5879 2312 FPD/AG BRG/SF IADC 437X

LEVEL	COMPONENT	REV	DESCRIPTION	QUANTITY	UOM
2	D0021740	A	DWG 077-097 DOMEVENT II RSVR ASSY (PRO-E)		
2	0021735	A	077-097 CANNISTER: DMVT II	3.000	EA
3	D0021735	A	DWG 077-097 CANNISTER: DMVT II (PRO-E)		
2	0021710	--	077-097 DMVT II RSVR BOOT ASSEMBLY	3.000	EA
3	D0021710	--	DWG 077-097 DMVTII RSVR BOOT ASSY W/9RIBS		
3	0021909	--	077-097 BOOT RUBBER: (PRO-E)		EA
3	0021711	--	077-097 DMVT II BOOT REINFORCING SLEEVE		EA
4	D0021711	--	DWG 077-097 DMVT II BOOT R.F. SLV (PRO-E)		
3	0021712	B	077-097 DMVT II BOOT DISC		EA
4	D0021712	B	DWG 077-097 DMVT II STEEL BOOT DISC (PRO-E)		
4	50-6(N)	-	SPEC - 50-6(N)		EA
2	0021736	--	077-097 RSVR END CAP: DMVT II	3.000	EA
3	D0021736	--	DWG 077-097 RSVR END CAP: DMVT II (PRO-E)		
2	0021713	A	077-097 BELLEVILLE SPRING: DMVT II	3.000	EA
3	D0021713	A	DWG 077-097 (STAINLESS)B-SPRING: (PRO-E)		
3	50-6(L)	-	SPEC - 50-6(L)		EA
2	0021737	--	077-097 DMVT II RETAINING RING	3.000	EA
3	D0021737	--	DWG 077-097 RETAINING RING (PRO-E)		
2	0017620	A	PIPE PLUGS (FLUSH TOP) 1/8-27 - 7/8 TAPER	3.000	EA
3	D200049	A	DWG PIPE PLUG (FLUSH TOP) (PRO-E)		
2	0016327	-	077-097 CANNISTER O-RINGS MAT'L NBR-R	6.000	EA
3	D093799	A	DWG O-RING STATIC		
	9970669	C	O-RING STATIC AS 568-218 / 95 SERIES	3.000	EA
2	D093799	A	DWG O-RING STATIC		
	9930677	A	BOX ASSY (C) 7 5/8 - 7 7/8 3-CONE BITS	1.000	EA
2	9930659	A	BIT BOX C,CC 075 - 077 ALL TYPES	1.000	EA
3	D090378	L	DWG BIT BOX PRINTING & INSIDE DIMENSIONS		
2	9930660	-	BOX LINER (CC) 7 5/8 - 7 7/8 ALL TYPES	1.000	EA
3	D090379	H	DWG BIT BOX LINER		
2	0004897	-	BOX STABLZR (C) 7 5/8 - 7 7/8 ALL TYPES	1.000	EA
3	D095287	E	DWG BIT BOX STABILIZER		
2	9930043	-	BOX TOP (C) 7 5/8 - 7 7/8	1.000	EA
3	D090380	J	DWG BIT BOX TOPS & BOTTOMS		
2	9930044	-	BOX BOTTOM (C) 7 5/8 - 7 7/8 (PLYWOOD)	1.000	EA
3	D090380	J	DWG BIT BOX TOPS & BOTTOMS		
2	9930663	A	BOX BOTTOM (C) 7 5/8 - 7 7/8 (FIBRBOARD)	1.000	EA
3	D090380	J	DWG BIT BOX TOPS & BOTTOMS		
2	0018573	--	BIT BOX LABEL (LARGE)	1.000	EA
3	D200136	A	DWG BIT BOX LABEL (LARGE)		
3	0017781	-	BIT BOX LABEL (LARGE)	1.000	EA
3	0017782	-	BIT BOX LABEL (LARGE)	1.000	EA
	9860483	-	BIT GREASE STL-057	1.000	LB
2	9860484	-	GREASE-BRG & O-RING-TEXCLAD #2	0.500	LB
2	9860485	-	PIN PROT COATG-TEXACO COMPND "L" RUST PREV	0.125	LB
2	9860486	-	WELD FILLER-SEAMS & CROWN-AWS E70S-6	1.000	LB
2	9860487	-	WELD FILLER-BALL HOLE PLUG-AWS E70S-6	0.125	LB
	0000091	-	VEE SHIM/OSVB 073 - 077 BITS	1.000	EA
2	D039769	B	DWG VEE SHIM/OSVB		
	0000092	-	SIDE SHIM/OSVB 073 - 097 BITS	3.000	EA

Smith International *** PONCA CITY *** Date: 08-MAR-00
Smith Tool Indented Bill of Material Report Page: 4

Item: 0026557 Size: 077 Type: F10T Features:
ER: 5879 IADC: 437X Pin Size: 4 1/2 BRG #: 525 - -0540
Rev: -- EO: 24017 Status: E Rev Date: 06-MAR-00

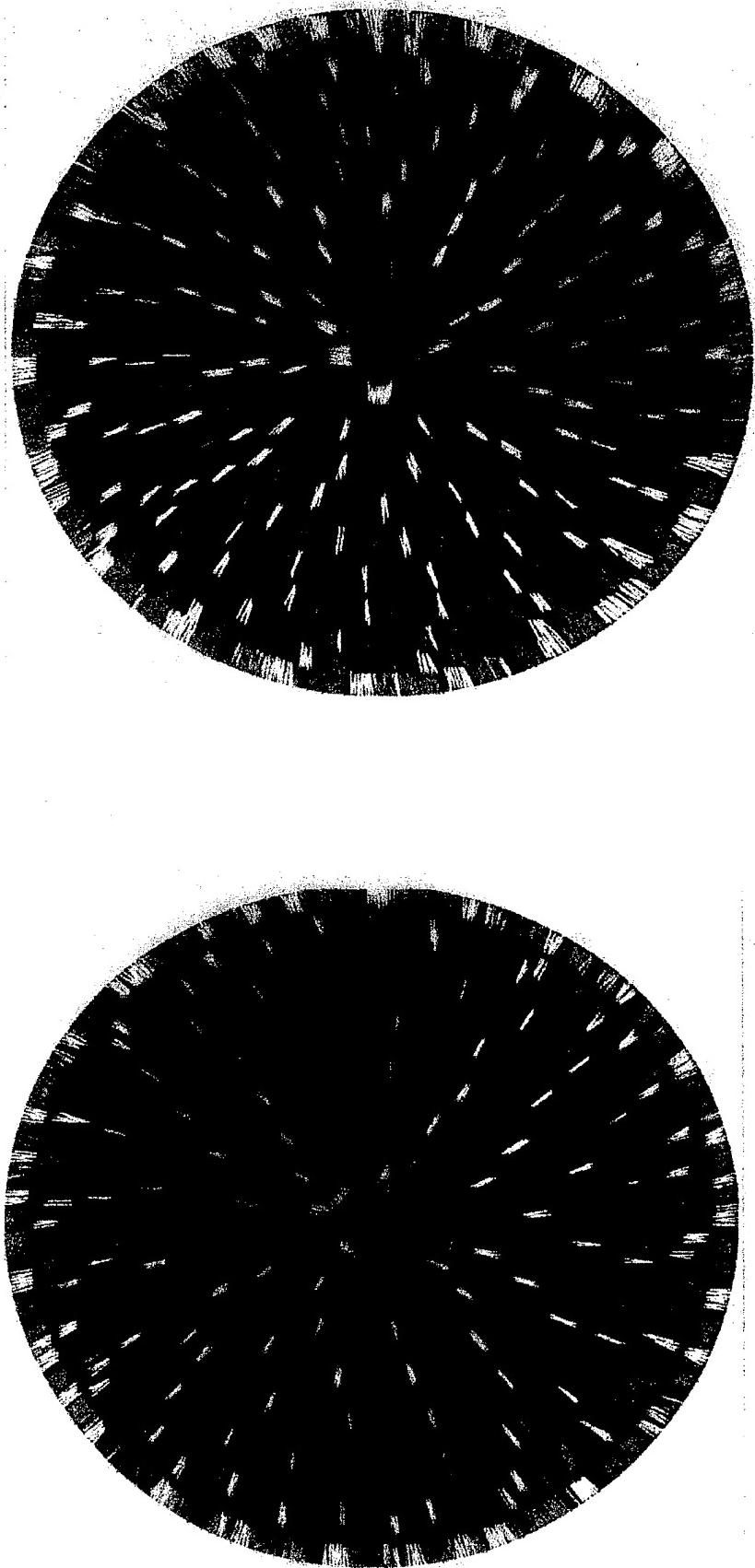
Item Description: 077 F10T ER5879 2312 FPD/AG BRG/SF IADC 437X

LEVEL	COMPONENT	REV	DESCRIPTION	QUANTITY	UOM
2	D044887	B	DWG SIDE SHIM/OSVB		
	9974315	A	DOME SHIM/OSVB 7 5/8 - 7 7/8 BITS	1.000	EA
2	D046369	A	DWG DOME SHIM/OSVB		
	0009960	-	BIT BOX LABEL #2 - "SCULPTURED" INSERTS	1.000	EA
2	D095644	-	DWG BOX LABEL #2 - "SCULPTURED" INSERTS		
	0014200	E	THRUST WASHER 1.059ID X 1.820ODX .070 SLV	3.000	EA
2	D098470	E	DWG THRUST WASHER (SILVER PLATED)		
	9860482	-	BIT PAINT-METALLIC GREEN LACQUER	0.250	LB
	D095459	A	SEAL SEL CHART		
	D205379	--	DWG LAYOUT LT077-F10T-04		

*** End of Report - INDENTED Bill of Material Report ***

077 ER589

STD 077 F47H



IDEASTM Bit Design: 7 7/8 ER5897 (F47H)



SMITHCOLOR0039
CONFIDENTIAL

STD 077 ER



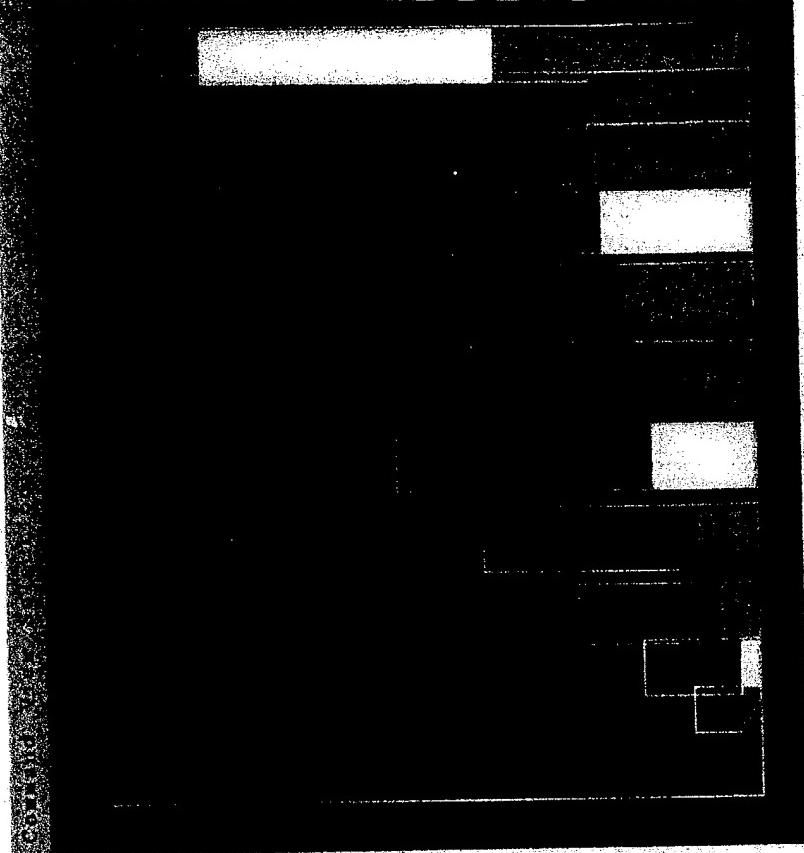
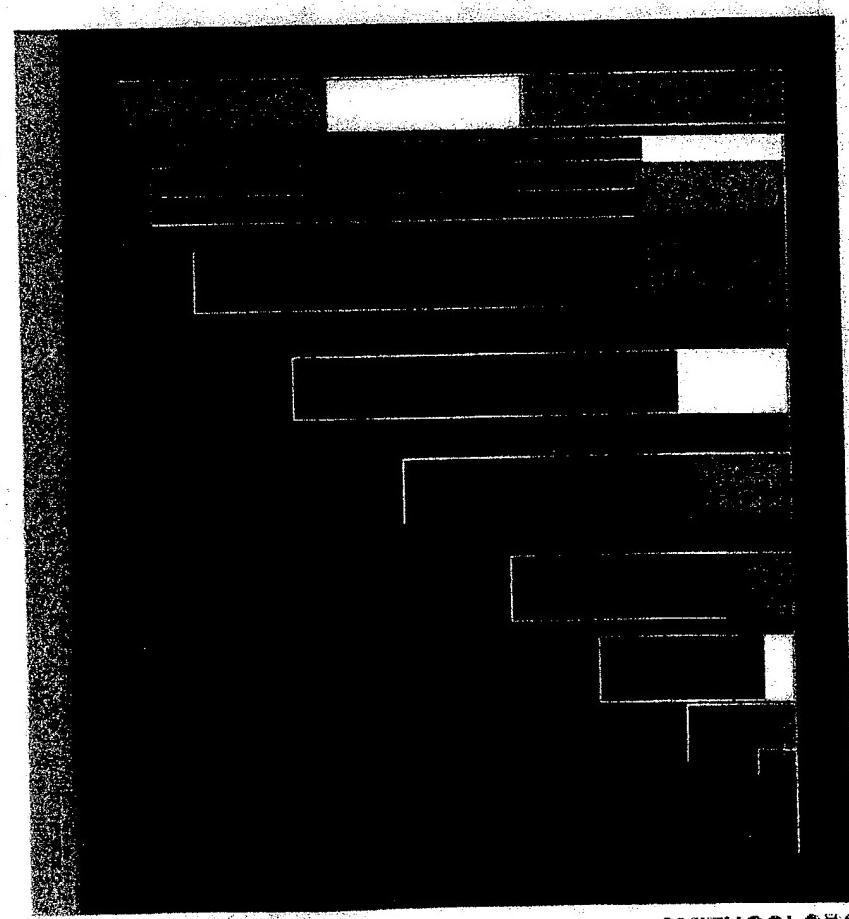
077 ER5897

SMITHCOLOR00394
CONFIDENTIAL

IDEAS™ Bit Design: 7 7/8 ER 5897 (F47H)

STD 077 F47H

077 ER5897



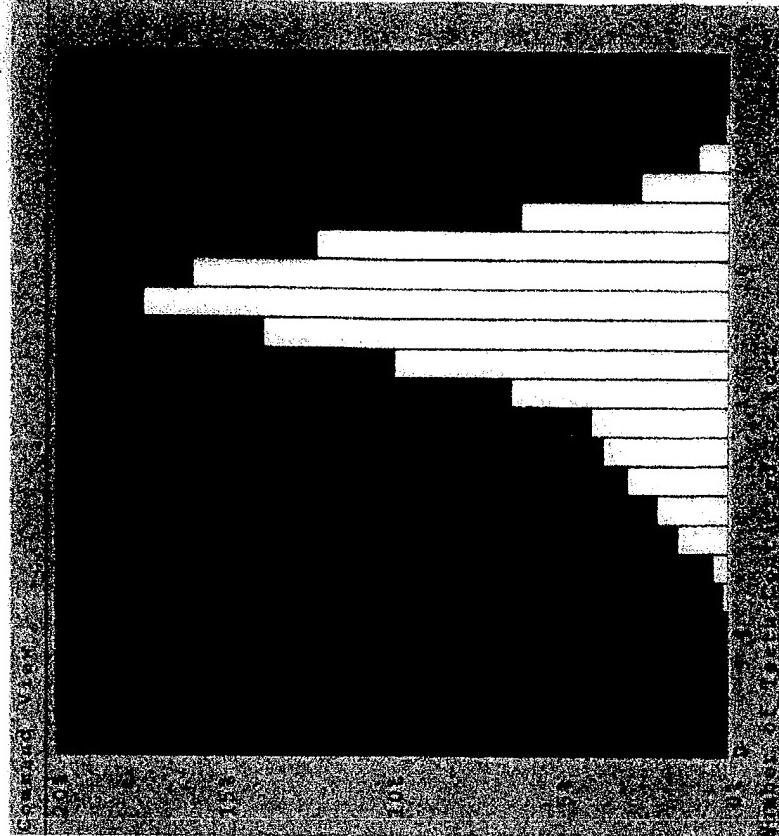
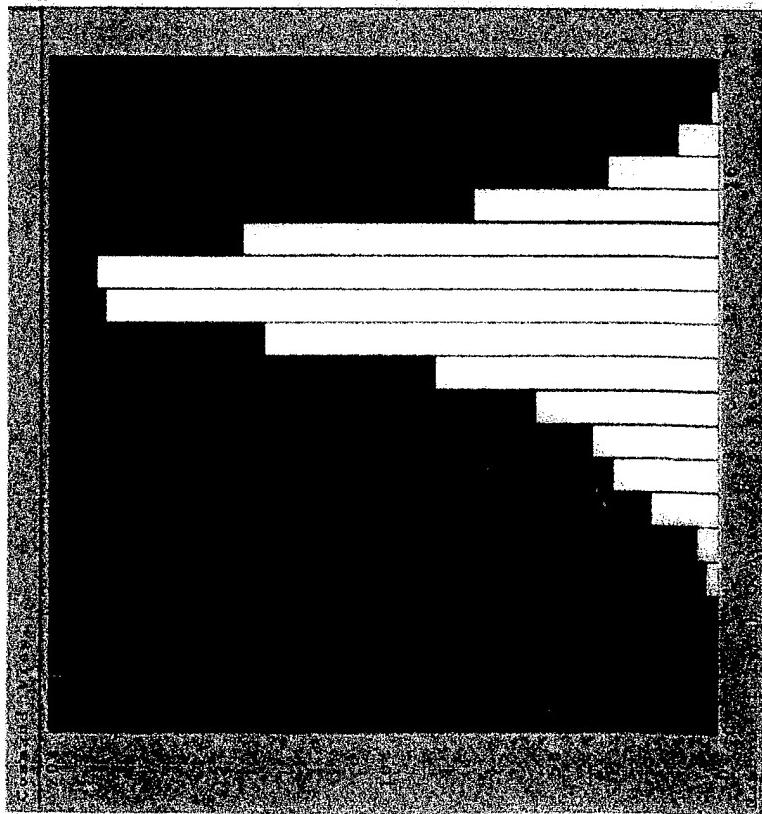
SMITHCOLOR0039
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IDEASTM Bit Design: 77/8 ER5897 (F47H)

STD 077 F47H

077ER5897



SMITHCOLOR00396
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